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HYGIENE:

OR,

THE PRINCIPLES OF HEALTH,

ADAPTED TO THE REQUIREMENTS OF

The Science and Art Department, South Kensington.

BY

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PREFACE.

IN July, 1883, the Science Department of the Committee of Council on Education issued a syllabus of Hygiene. Having been appointed to prepare students for the examinations to be held by the South Kensington authorities in this subject, I soon found that, in spite of the many manuals and smaller text books which have been published on Health, no one was quite adapted to the Science Department's requirements, or built upon the lines of the South Kensington syllabus.

A special book would be hardly necessary if all students were regular in attendance at class, and if they took notes of the lessons and mastered the details of the same. Again, if students all answered the questions which are set on the lessons given, then teachers would be able to learn more of their difficulties and shortcomings.

Unfortunately, in large classes of adult students, many are frequently irregular; some take only few and imperfect notes of the lessons, which they themselves even cannot afterwards understand. As a rule, too, it is found that adult members of classes do not trouble to answer the questions which are set on the subject. These, and other facts of a similar nature, have induced me to publish for the use of students the notes of my lectures with some extended explanations. The *primary object* in view, therefore, in writing the following pages, is to provide such information as will aid those who are preparing for the South Kensington Examination. A *second object*, but by no means a subordinate one, of these "Elements of Hygiene" is to explain, in a simple manner for the general reader, some of the great natural laws connected with the subject of health, taking as a guide the systematic outlines of the syllabus recently issued by the Science Department.

In such limited space, where one has to deal with so many important and vital questions, full of the very deepest interest to us all, it must necessarily follow that much remains unsaid. For example, in treating

of the questions of "Food" and "Breathing" I have not dealt with the structure and functions of the digestive and respiratory organs, not because such knowledge is not important nor that the study of Physiology can be separated from that of Hygiene, but because, in the first place, space will not allow of such treatment, and in the second, the Science Department indicates by its syllabus that students must have some knowledge of Physiology before the study of Hygiene is taken up. Such information with respect to Human Physiology, as is necessary to the study of Hygiene, may be derived from my "Elementary Physiology."

I am indebted to *Messrs. Boyle, Banner, Buchan, Maignen, Doulton*, and the *Spongy Iron Filter Co.* for some of the illustrations, and to the *Royal Humane Society* for their instruction as to their mode of treating the apparently dead.

JOHN J. PILLEY.

DULWICH,
March, 1884.

PREFACE TO THE THIRD EDITION.

IN the present edition several changes of importance have been made in the text, and to meet the requirements of the new syllabus, a chapter has been added on the "Removal of House Refuse." In addition to these changes, and in order to make the book of greater value to students, questions have been written on the matter of each chapter, all the questions which have been set by the Science and Art Department in the Elementary Stage at past Examinations, and an index, have been added to the book.

J. J. P.

October, 1888.

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HYGIENE,

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PRINCIPLES OF HEALTH.

CHAPTER I.

INTRODUCTORY.

Hygiene: what it Teaches.—Preventable Diseases and their Results.—Need for Knowledge of Laws of Health.—The Study of Hygiene.—"How to Keep Well."—Waste of the Body.—Decay and Repair.—Uses of Food.

HYGIENE is the science which treats of the health of the body. It deals with those causes which are ever at work reducing the vigour of the body, rendering nutrition, development, and growth imperfect, and generally producing such effects as predispose our bodies to the attacks of disease. In other words, it has to do with those natural laws through ignorance, carelessness, or disregard, of which we invariably shorten our own lives, and very frequently the lives of those around us.

From statistics we learn that a very large number of victims are annually carried off by **preventable diseases.** But though we may know the number of those who die, statistics reveal nothing of the suffering, pain, and misery which attend and follow this wholesale destruction of life. The painful fact of the immense yearly sacrifice of human lives, the result of ignorance, selfishness, and carelessness, must be too well known to all. To this must be added an immense amount of silent suffering, of which we have no record, and the extent of which many can scarcely imagine. We can form only a faint idea of the magnitude of the preventable misery thus produced by careful observation of, and intercourse with, the neglected classes of our fellow-men. The strong man, the breadwinner of the family, whose health is ruined; the fatherless children compelled early, when

they are scarcely more than babes, to fight their battles with the world; the widow, who battles for her own life and that of her children against fearful odds; all alike too often tell the same story of suffering, the results of serious illness, of broken health, and loss of life, brought about by essentially preventable diseases. It is not alone among the labourers, or even the poorest classes, that this same grim story of wasted and ruined lives is told, but in the abode of wealth and rank, the same death-dealing and health-ruining enemies of mankind lurk. It may be in the atmosphere of the richly furnished but unhealthy room, on the weighted board with its costly but unwholesome dishes, or in the wine which flows at the meal which is thus converted into an unhealthy feast.

Even amongst the otherwise educated classes much sickness and disease is very often the result of a sad want of knowledge of the most simple laws of health. Where, too, the knowledge does exist, we often find the same effects produced by gross carelessness of the observance of hygienic rules. The yearly victims demanded by *consumption*, *typhoid* or *typhus fevers*, *small pox*, *diphtheria*, *scarlet fever*, *cholera*, and other epidemic diseases, tell in an awful manner how great is the need for instruction in, and observance of, elementary sanitary rules.

Hygiene embraces the study of the

Supply, *use*, and *abuse of food*, *water*, and *air*.

Personal cleanliness and *care of the body*, and *removal of impurities.*

Shelter and *warming.*

The dwelling in relation to health.

Preventable diseases and other questions of similar vital importance.

The object of the following pages is to make clear, as far as limited space will allow, some of the elements of "how to keep well," and it is hoped that such information may form the foundation of that knowledge, which, acted upon, will enable us to live healthier, longer, more useful and happier lives. Such knowledge

should be the sacred property of all, to be used to their own good and for the benefit of their fellow-men.

Waste of the Body.—All parts of our bodies are continually dying away and being removed, yet the change is so gradual that we do not generally notice any difference in the appearance of the whole from day to day. Sometimes the decay, death, and replacement becomes very evident to us, as, when a boil, abscess, or sore place of any kind occurs on the surface of the body, we see then how gradually the dead tissue is removed and new takes its place. If we are **young, healthy,** and **growing,** then the waste of the body is repaired, and new matter added faster than it dies away In **middle age** the amount of waste or wear of the body is about equal to the repair, therefore very little difference is observed in the appearance of healthy middle-aged people from day to day. The tissues of the bodies of **those advanced in years** wear away or decay slightly faster than they are repaired, hence they appear to gradually alter as they go down the hill of life. At all times during life this waste is surely going on. The flesh of our hands, for instance, at this moment is not precisely the same flesh as yesterday, or even one hour ago, some parts have been used up and carried away by the blood and thrown off from the body by the kidneys or lungs. New matter is every minute being taken from the blood by the living yet constantly dying structures.

We may liken our bodies to large buildings which are continually undergoing repair. You know that in many old buildings a new brick or stone or some new plaster is added here and there, the old is removed, yet the general appearance of the building is not altered. But if we require bricks and stones for the repair of different parts of the decaying building, we also require some agents to carry away the old stones and waste, others to fit the new stones for their places and prepare the bricks, plaster, and mortar; and others again to carry and place the new materials where required.

The nutritive matters taken into our bodies as food, which become part of the blood, are the repairing materials like the

bricks, plaster, etc., whilst the worn or old bricks are represented by the worn out tissues in the forms of carbonic acid gas, urea, etc. In our bodies the canals along which the nutritive matters and waste materials flow are blood-vessels.

How do we know that all parts of our bodies are continually wasting? If you expose some clear limewater in a shallow vessel to pure air, it will remain clear for a long time; but if you breathe into it, after a few seconds it becomes thick and milky white. This simple experiment proves that something is given off in our breath which has the power to change the clear lime-water. The body which possesses this property is known as carbonic acid gas. Hence, we may easily prove that **the lungs continually give off carbonic acid gas.**

FIG. 1.—LIME-WATER EXPERIMENT.

On a cold morning you have seen a cloud of vapour leave the mouth, and you may have said that you could see your breath. The cloud is due to the watery vapour in the air which comes out of the lungs. We must remember that this vapour is sent off from the lungs at *all* times, but we only see it when the air is cold, just in the same way as we only see a cloud of vapour leaving the mouth of the tea-kettle on a cold day, but no such cloud is visible when the air is warm. *Water and carbonic acid are given off from the lungs.* The same substances are given off from the sweat glands of the skin, and urea and water are excreted by the kidneys. A quantity of solid matter also passes off daily from the digestive canal.

It is well known that the body is maintained during life at a nearly constant temperature. The bodily heat is produced by the burning in all parts of the body of certain of the elements of the food. The waste products resulting from this combustion are got rid of by the lungs, skin, and kidneys. If then the body is continually losing these substances, it is necessary that we should make good the loss, if the weight of the body is to remain constant, or if it is to increase. The loss of matter is made good by the substances which are taken into the body as food. In other words then we may say the following duties devolve upon food :—

1. **To furnish matter to build up growing tissues.**
2. **To make good loss and renew decaying or wasting structures.**
3. **To supply force for performing work.**
4. **To maintain the heat of the body.**

CHAPTER II.

FOOD.

Kinds of Food.—Substances.—Water as a Food.—Amount required Daily by a Healthy Adult.—How Taken.—Flesh-forming Substances and their Duty in the Body.—Fats.—Heat Producers—Saline Substances of Food and their Use.

THE substances present in food may, for the convenience of study, be classed as **Water, Nitrogenous Compounds, Carbohydrates, Fats,** and **Salts.**

Water forms about 79 parts out of 100 of the weight of the blood, and about 75 per cent. by weight of the solid structures. It is such a general solvent that by means of it nutritive matter is carried to all parts, and it is equally necessary for the removal of the decaying and wasting matters. An average adult loses 70 to 100 ounces of water daily, and requires, therefore, from $3\frac{1}{2}$ to 5 pints to make good the loss. About $\frac{1}{3}$ of this amount is obtained from the ordinary solid food taken, for it must be remembered that even the driest of the solid foods contain much water; for instance,

cheese contains about $\frac{1}{3}$ its weight of water. In addition therefore to the amount thus taken in solid food, from $2\frac{1}{2}$ to $3\frac{1}{2}$ pints are required, and should be taken as drink in some form in twenty-four hours. It is well to remember that **all animal and vegetable foods contain water**; thus *green vegetables* contain from *90 to 95 per cent.*; dried seeds, like *peas* and *beans*, *13 per cent.*; *bread*, *35 to 40 per cent.*; *lean meat*, *70 to 75 per cent.*

Water is not only a true food, but aids in the solution of other foods, and in the removal of the *wasting and worn-out matters.* The general action of the water will be considered later.

Nitrogenous, structure-forming, or **tissue-building food-stuffs** *are obtained both from the animal and vegetable food we eat.* They are chiefly used in repairing the waste of the body, and building up the growing tissues. In some cases they furnish material for combustion, by means of which the temperature of the body is maintained, but for the latter purpose they are wasteful foods. When animals are fed on food in which nitrogenous substances are wanting, they rapidly decrease in weight, and die from what has been termed by physiologists "**nitrogen starvation.**" At the same time nitrogenous substances taken as food are not alone sufficient to keep the body in a healthy state for any length of time. This class of food includes two groups of substances, one containing **proteids** or **albuminoids**, and the other **gelatin** and **gelatinoids.** The albuminoids rapidly renew the wasted and worn tissues of the body, and hence are very useful in great labour.

Carbohydrates or **amyloids** include the various *starches*, *sugars*, and *gums* which are *largely present in foods of vegetable origin.* They have no nitrogen in them, and are therefore incapable of building up the growing tissues of the body. Within the body they assist in the **production of heat,** and are doubtless in some cases changed into fat, which is deposited in the tissues. The amyloids are allied to fats in composition, but they are more digestible. The sugars are soluble, and hence easily dissolved by water, and carried into the blood stream.

Starchy foods must be cooked in order to be digested, because the little insoluble grains of starch which they contain are locked up in small cellulose bags or cells. During cooking, the cellulose is ruptured, and the granules of starch are liberated, and may then be acted upon by certain of the digestive fluids. The *saliva* or spittle contains an active principle, *ptyalin*, which changes starch into a form of sugar known as grape sugar. It is therefore desirable that **starchy food should be slowly masticated** in the mouth, in order that all parts may be thoroughly mixed with the saliva.

Fats may be of **animal** or **vegetable** origin. They are as necessary to the well-being of the body as the nitrogenous matters, although they do not directly aid in the formation of flesh and similar tissues. Fat is found diffused around all the tissues, thus giving roundness and plumpness to the body. When it is deficient, then the individual is said to be lean or thin. If fatty matters are taken in excess, they are then deposited in the tissues where their accumulation leads to stoutness.

The fats taken as food are not simply re-deposited in the body, but are all more or less changed, and are the great sources of combustible material.

Saline matters are required in the blood in varying quantity for all the tissues of the body. *Common salt* (*chloride of sodium*) is necessary for digestion and essential for health. You may have heard how wild animals are sometimes caught by placing salt on the ground, the animals come to lick it and are then captured. The desire for this necessary substance is well shown in the "salt licks" of North America, to which wild animals resort for hundreds of miles in order that they may satisfy their cravings, and furnish salts to the blood. Those who have watched the ravenous way in which laying hens pick up and swallow small pieces of oyster shell, fragments of egg shells, or other limy matters, have learnt how great must be the craving for the lime which enters the blood and from which the solid covering of the egg is prepared.

Many salts are found in the body ; *chloride of sodium* is necessary

for the production of the hydrochloric acid of gastric juice in the stomach. The human body contains about three ounces, which chiefly exist in the blood. *Potassium salts* are present in blood, flesh, and milk. *Salts of lime* are necessary for the formation of bone, and hence are required in especially **large quantities by the young.** When the food given to young children is deficient in these substances, **rickets** frequently results. Lime salts are present in most animal and vegetable foods in varying proportions, but perhaps the best source from which they can be obtained, especially for the young, is milk. *Salts of magnesia*, *oxide of iron*, and *phosphates* are also found in the blood, and are present in many of the tissues.

CHAPTER III.

FOOD STUFFS.

Nitrogenous Food Stuffs. — Albumen. — Casein. — Myosin. — Fibrin. — Legumin. — Gelatin.—Gluten.— Carbonaceous Substances.— Starch.— Sugar.—Gum.—Oil and Fat.—Mineral Substances and When Obtained.

THE most important **nitrogenous** or **tissue-forming substances** present in foods are *albumen*, *casein*, *myosin*, *fibrin*, *legumin*, *gelatin*, and *gluten.*

Albumen is obtained from white of egg; when fresh, it is a clear and transparent liquid, but if boiled, it coagulates, and becomes white and opaque. It is contained in the liquid part of the blood known as *serum.* Milk also contains dissolved albumen. Many vegetables contain an allied substance, known as *plant albumen.*

Casein is present largely in milk and cheese. The addition of a little acid, such as vinegar, will cause milk to separate into curds and whey. The curd contains most of the casein.

Myosin enters largely into the composition of flesh or muscle.

Fibrin is present in lean meat, and in blood. A substance known as *plant fibrin* occurs in most of the cereals.

Legumin is a flesh-forming substance which is present in many vegetables. Peas, beans, and lentils contain much legumin. It is very much like casein, so much so, in fact, that it has been called *vegetable casein.*

Gelatin is obtained by boiling bones; it exists also in skin and cartilage. Experiments prove that life cannot be sustained when this is the only nitrogenous matter taken as food. Although when used alone it appears to be only of little value, yet, if only a small quantity of other nitrogenous matter is taken with it, the animal flourishes. Glues of all kinds are forms of *gelatin,* with impurities, which are obtained by boiling the hoofs, hides, and horns of animals.

Gluten is contained in the cereal grains, such as wheat, oats, etc. It is so much like fibrin that it has been called *vegetable fibrin.* If a little flour be placed in a piece of linen or muslin, and a stream of water be allowed to run on it, as the water leaves the paste it will be quite milky, and if collected, the white powder which makes it milky will settle at the bottom of the vessel. The powder thus obtained from the flour is starch. The substance which remains in the linen or muslin is very unlike flour or dough, in fact it is a very sticky substance, not unlike birdlime, and is nearly pure gluten. All the food substances mentioned above are composed of the elements—oxygen, hydrogen, nitrogen, and carbon, associated with which are traces of sulphur and phosphorus, and they build up flesh or muscle in the body. You must remember that both plants and animals contain these muscle-building food materials. Of vegetables: peas, beans, and oatmeal contain most flesh-forming matter.

The most important **Carbonaceous food stuffs** are *starch, sugar, gum* (Carbohydrates), and *oil* and *fat.*

Starch is present in *all* vegetable foods; rice, potatoes, arrowroot, tapioca, oats, rye, and maize, contain large quantities.

Cut a potato in halves, and then rub the two cut faces together, allowing at the same time a stream of water to run on them. If

the liquid, which becomes thick and whitish, is caught in a vessel, and allowed to stand for a time, a layer of white *potato starch* will fall to the bottom.

All kinds of starch contained in our food are changed into a kind of sugar, known as *grape sugar*, before they are made use of in the body. Grape sugar is not so sweet as ordinary cane sugar.

Sugar is contained in most vegetable foods. It is a soluble substance, that is—it is easily dissolved when placed in water. Carrots, parsnips, beetroot, etc., contain large quantities of sugar.

Gums are also contained in all kinds of vegetable foods. They vary in character just as sugars vary. Like sugar, gum is soluble.

Oil and *Fats* are contained both in animal and vegetable foods. The nuts and seeds of plants contain much fat. Most of you have doubtless heard of cocoa-nut fat, and linseed and other vegetable oils.

Mineral, or **saline food substances,** are taken into our bodies in all our solid and liquid foods.

We know that when a kettle has been used for some time it becomes coated inside with white fur. This layer of matter contains salts of lime, magnesia, etc., which have been deposited by the water; hence, clear drinking water contains mineral matter. All animal and vegetable foods contain mineral matter. You know that if a cabbage leaf is thrown on the fire, most of it is burnt, but a white ash of mineral matter remains.

It is essential for the life and well-being of any animal that it should receive certain quantities of **food** belonging to each of the **four classes.** An animal could not live for any length of time on *fat-forming food alone*, nor could it subsist on a purely nitrogenous diet. It requires food containing *water* to make good the loss, and assist in the solution and distribution of other foods: *nitrogenous* matter to repair muscle and build up the tissues, *carbonaceous* compounds to keep up the heat of the body and renew the fat, and *mineral* substances to form bone.

CHAPTER IV.

ANIMAL NITROGENOUS FOODS.

Animal Food.—Fish : its Components.—Its Value as Food.—Best Kind of Fish.—Birds : Value as Food.—Digestibility of Rabbit.—Butchers' Meat.—Nutritive Value of Different Kinds of Meat.—Beef.—Veal.—Mutton.—Lamb.—Pork.—Bacon.—Eggs.—Cheese.—Digestibility of Cheese.

ANIMAL *Nitrogenous Foods.*—Under this heading we shall learn something of those animal foods which contain substances rich in nitrogen, such as albumen, casein, etc. This class includes the *flesh of animals*, *eggs*, *milk*, and *cheese.*

The value of different kinds of flesh as foods depends upon the per-centage and character of the nitrogenous and other matters present, and upon their digestibility. All meat contains a considerable per-centage of water and fat; even the leanest kind of meat contains fat incorporated with the flesh or muscular fibre.

Fish.—The flesh of fish, in common with other muscular fibre, contains nitrogenous matter—**albumen, gelatin, fibrin.** It is as a rule rapidly digested, but usually contains less flesh-forming matter than the flesh of birds or mammals. It contains a larger quantity of mineral matter, generally in the form of **phosphates,** and less fat than ordinary meat. In consequence of the small quantity of fat usually present in the flesh of fish, it becomes necessary to make up the deficiency by the addition of butter or fat of some kind during the process of cooking. When fat is fairly diffused through the flesh, as in the **salmon,** such dressing is not required, and it is doubtless within the experience of many that such fish is more satisfying when taken as a meal than the drier kinds, such as cod.

The value of fish as a food depends upon certain conditions :—

1. *It is always most nutritious, and best as food, when fresh.* **Salmon** and **mackerel** *should be prepared for the table as soon as possible after they are caught.*

2. *Fish attains its highest nutritive value, and is generally in the best condition for food, just before spawning.*
3. *When out of season it is unfit for food, and may be known at once by a semi-transparent character, and want of firmness on the part of the flesh.*
4. *A tough, dry, and woolly character generally indicates that the fish is indigestible.* Those fish which contain least oil and fat are the most wholesome, but, as above explained, the deficiency of carbonaceous matter must be made good by serving with butter or starchy foods. Whiting contains least fatty matters, is highly nutritious, and easily digested when boiled.
5. *The nutritive character and digestibility of fish are largely determined by the way in which it is prepared for the table.* For preparing fish for the table it should be thoroughly cleansed and well cooked.

This subject will be treated further, under the head of cooking.

The **sole, whiting, plaice, turbot, flounder, pilchard, cod,** and **herring** are, when well cooked, the most **easily digested** of fish. The **crab, lobster,** and similar crustaceans, with **salmon,** are difficult to digest.

Birds.—The flesh of birds contains **albumen, gelatin,** and **fibrin**; it is rich in **phosphates,** but usually contains **very little fat and iron.** The deficiency of iron compounds may be made up by serving with rich beef gravy or some prepared from "Liebig's Extract." Albumen and gelatin are more abundant in the flesh of young birds, whilst fibrin occurs in larger quantities in the flesh of old birds.

Fat is generally only present in small quantities, as above explained; but this is especially the case with wild birds. To make up for this natural deficiency, fat is added during the process of cooking, or is served with the dish at the table. Thus, melted butter, bacon, or pork sausages are eaten with boiled chicken. When fat is present with the flesh, the meat is certainly more

difficult to digest, especially when roasted. The fat of **ducks** and **geese** is often injured during roasting, a strong peculiar flavour is then brought out. This is often masked by using seasoning of sage and onions, which possesses a stronger odour and taste, but which is indigestible, and to many is decidedly objectionable.

The flesh of most birds is edible, but that of flesh-eating varieties has generally a strong flavour. The flesh of the **common fowl, pheasant, partridge, pigeon, turkey,** and **guinea-hen** is nutritious and easily digested. The amount of fat present, and the closer character of the muscular fibre of the **goose, duck,** and **teal** make these more difficult to digest.

Rabbits are easy of digestion; their flesh, like that of birds, contains only a little fat. The flesh of the wild rabbit is more palatable and more digestible than that of the domesticated varieties. The flesh of the rabbit is more digestible than that of the hare, but usually contains less nutritive matter. The defect in fat may be made good by serving with fat pork or bacon.

Butchers' meat.—The composition and value as food, of any kind of meat, varies with the kind of animal, with the age, with the same class of animals under different conditions, and with different joints from the same animal. The proportion of fat present varies very much. The amount of water is in all cases large; but as a rule, the larger the quantity of fat present the smaller the proportion of water. Lean meat furnishes the largest quantity of nitrogenous or flesh-forming matter. When carbonaceous or force-producing matters are required, as during hard work or in cold climates, then fat meat is more suitable and economical. Animal food is highly favourable to hard work, it contains in a concentrated and available form important nutritive matters.

Roast meat, all other conditions being the same, is more nutritious, weight for weight, **than boiled meat,** for **more nutritive matter is lost in boiling than in roasting.**

Beef contains less fat and more nutritive matter than pork or mutton, weight for weight. **Ox beef** is one of the most strengthening

and highly nourishing of animal foods. **Bull beef** is dry, tough, and indigestible. **Cow beef** is not so tender, nor is it so nourishing or digestible as ox beef. Nevertheless, a great deal of cow beef finds its way into the markets of our large towns. The dairy cows ceasing to yield milk, the dealer fattens them and prepares them for the market.

Veal contains less nutriment, and is not so easily digested as mutton or beef. To prepare the light or whitish-coloured veal for the market, the flesh is deprived of its blood, and consequently of much of its saline matter also. The salts are generally re-supplied by serving with a rich gravy prepared from good beef or "Leibig's Extract." The deficiency in fat is generally made up by serving ham or bacon with joints of roast veal.

Mutton appears to be the **most digestible of this class of food,** and hence is especially to be recommended to those of sedentary habits, and to invalids. Wether mutton appears to be the most wholesome and nutritious.

Lamb is less dense and more watery than mutton. It serves as a light and wholesome food, especially when the lamb is four or five months old.

Pork contains a much larger proportion of fat than beef or mutton. In consequence of the close and compact nature of the muscular fibres, and the quantity of fat present, it is difficult to digest. It is important to remember, though, that the nature of the flesh of the pig is largely determined by the age, breeding, and conditions under which it is kept. Although it may be wholesome for hard muscle workers, and those exposed to cold, yet, when taken by those of sedentary habits, it favours inflammatory and skin diseases. In all cases, those should abstain from pork who are suffering from impure state of the blood, wounds, boils, ulcers, or skin diseases of any kind, and those subject to indigestion.

Pickled Pork is more easily digested than either boiled or roasted fresh pork.

Bacon is prepared from pork by salting, drying, and smoking;

during the process of curing, the quantity of water is decreased, whilst the proportion of mineral matter is increased. Much difference of opinion exists with respect to the digestibility of bacon; some go so far as to advocate it as a remedy for indigestion. Now, although the digestibility of the fat is doubtless increased, yet the muscular fibres are toughened and consolidated by salting and drying, and are therefore rendered more difficult of digestion.

Not only is pork one of the most difficult of meats to digest, but it is one the use of which is attended with very great danger, because it is so frequently diseased.

Eggs are very nutritious; they contain as much flesh-forming matter and fat as an equal weight of good meat, but are somewhat deficient in mineral matters, which are mainly present in the shell. In the sick room they are among the most valuable and nutritious articles of diet. The eggs of the common hen are consumed in enormous quantities by man. They vary in weight from $1\frac{3}{4}$ ozs. to $2\frac{1}{4}$ ozs. Those which are fresh always weigh more than those which have been kept for a time. The loss in weight is due to the evaporation of some of the water, the place of which is taken by air. In time, the oxygen of the air which has thus gained entrance brings about decomposition. Eggs may be preserved by smearing over them lard, fat, or butter, which closes the minute pores of the shell, and prevents the interchange above alluded to. When eggs are washed in lime-water, the water passes off as vapour, and the lime serves to close up the pores in the same way as butter, and hence prevents access of air and decomposition. Eggs may be kept for a long time by placing them in brine. Stale eggs may at once be recognised by putting them in strong brine, which has been prepared by adding to half a pint of water one ounce of common table salt; in such a solution, a stale egg will float, and a new laid egg sink.

Cheese is made from the curd of either *whole milk*, *skim milk*, or from *curd to which cream has been added*. Thus, there are three sorts of cheese—*whole-milk cheese*, *skim-milk cheese*, and *cream*

cheese. Cheddar cheese represents the composition of a good whole-milk cheese prepared from rich milk. Stilton and Gorgonzola are richer than Cheddar, and stand between it and cream cheese. Dutch cheese and Suffolk cheese may be considered as types of skim-milk cheese. Between these and the Cheddar, we have Cheshire and Gloucester cheese.

Cheese consists of water, casein, fat, and mineral matter. One pound of Gloucester cheese contains about five ounces of dry flesh-forming matter. Naturally, cheese has a pale straw colour, but the rich dark yellow, or orange tint, is generally artificially produced by the addition of *annato* during the preparation. The digestibility of cheese varies with its composition, age, and mode of preparation. As a rule, **cheese is not easily reduced by the digestive fluids,** but its digestibility may be considerably increased by reducing it to a powder. When **toasted,** it is very **indigestible.** Cheese from one to two years old, with a moist crumbly character, and fairly rich in fat, is rapidly and generally completely digested. The mildew, or blue mould, which appears on old ripe cheese, is due to the growth of a low form of vegetable life. Cheese maggots, or "jumpers," are the larvæ of the cheese fly *(piophilus casei)* which deposits its eggs in the cheese. The common cheese mite is *acarus domesticus.*

CHAPTER V.

ANIMAL CARBONACEOUS FOODS.

Value of Animal Foods as Heat Producers.—Butter.—Kinds of Butter.—Butterine.—Cream.

CARBONACEOUS **animal foods.** All forms of animal food contain some carbonaceous matter in the form of fat; some contain only a very little, as in whiting and fowl; others much, as in pork and mutton. **The majority of animal foods are chiefly valuable as flesh-formers and not as heat-producers;**

and those which yield much carbonaceous matter do so in the form of fat.

Butter, in its pure state, consists chiefly of the fatty matter of milk. It is prepared either from cream or whole milk by churning. All butter contains some casein, which is taken from the milk with the cream. When much is present, the butter is said to have a cheesy taste. The best butter contains very little casein, not more than three to five per cent. Butter which is made from sweet cream contains less casein, has a sweeter taste, and keeps longer than that prepared from sour cream. The character of milk and butter alike are largely influenced by the kind of food given to the cows, and the way in which they are kept. If the cows are fed with large quantities of strong turnip, the butter has a most decided taste in consequence.

The fat of butter, which in good samples varies from 88 to 92 per cent., consists of a solid fat *palmitin* and a liquid fat *olein.*

Salt is added to butter to preserve it. Even fresh butter contains a small per-centage of salt. Ordinary salt butter contains from three to six per cent. of sodium chloride.

Butter is very frequently adulterated before it finds its way to the consumer. The following substances are among those most commonly employed, beef and mutton fat, lard, and "bosch" or butterine. Water and salt are also often employed to increase the dishonest gains of the vendor. In moderate quantities, butter is not difficult of digestion, and is valuable as a food because of the large proportion of carbonaceous matter it contains.

Butterine is a kind of imitation butter now made from animal fat, on a large scale. Usually it is wholesome and cheap, although not so easily digested as true butter. Unfortunately, it is largely used to adulterate pure butter, and often people pay 1/6 or more a pound for a compound which is sold as prime fresh butter, but which really contains a large per-centage of this substance. The vendors say that the public prefer to pay a high price for something which, at all events, has the name of prime butter, rather

than pay 9d. a pound for the same substance under the name of buttcrine or "oleomargarine."

Cream is the fatty matter which floats to the surface of new milk, whcn it is allowed to stand for a time. It contains from 30 to 40 per ccnt. of butter fat. Cream is more digestible than butter, and hence is of great use in many cases as a drink for invalids.

CHAPTER VI.

VEGETABLE NITROGENOUS FOODS.

Vegetable Foods which contain much Nitrogenous Matter.—Peas, Lentils, Beans.—Glutenous Foods.

LEGUMINOUS **foods** include those vegctables which contain nitrogenous matter in the form of legumin or vegetable casein, associatcd with which there is always a considerable quantity of starch, sugar, cellulose, etc. We have examples of such in the seeds of **peas, lentils, and all kinds of beans.** These all contain a larger quantity of flesh-forming matter, in proportion to heat-producing substances, than any of the cereals. In the green state, the leguminous foods contain more water and sugar, in proportion to legumin, than when ripe and dry. **Fresh green peas and beans** well cooked are more digestible than when dry. When split or ground **dry peas** are added to soup, they form a wholesome, nutritious, and economical dish. When dry ripe peas are cooked alone, as in the preparation of pea-pudding, they require long steady boiling.

Many of the specially prepared foods for invalids and infants contain considerable quantities of leguminous matter; for example, the preparation known as "Rcvalcnta" contains barley-flour mixed with powdcred lentils. Sir Henry Thompson says—"for our labourers, probably the best of the lcgumcs is the haricot bcan, red or white, the dried mature bean of the plant whosc pod we eat in the early grccn stagc, as thc French bean."

Glutenous foods.—The nitrogenous substance, gluten, occurs associated with starch, sugar, cellulose, and salts, in the seeds of the cereals. *Wheat, biscuits, macaroni, vermicelli, bread, oatmeal, barley, malt, rye,* and *Indian corn* or *maize,* all rank as glutenous foods.

Brown bread is more nutritious than white bread, because it contains more nitrogenous and phosphated matter. It is generally prepared by adding fine **bran** to the ordinary components of white bread. These fragments of bran act in many individuals as irritants, stimulating the activity of the digestive canal. In cases of constipation, therefore, it may be useful, but, owing to its irritating action, it is not good for those with delicate stomachs.

When bread is made from whole meal instead of from fine flour, or as above, a highly nutritious and useful variety of brown bread is obtained. Bread made from **seconds flour** is more nutritious, too, than white bread.

Oatmeal porridge is an easily digested, wholesome, nutritious, and economical food, containing much nitrogenous matter.

CHAPTER VII.

VEGETABLE FOODS, STARCHY, Etc.

Starchy Foods.—Rice, Potatoes, Artichokes.—Starchy Matters not Muscle-Building.—Vegetables and their Value as Food.—Fruits.—Their Composition, Digestibility, and Value as Food.

STARCHY **foods.**—Farinaceous, starchy, or amyloid foods, are those which contain a large proportion of starch, or sugar. We have examples of such in *rice, potatoes, sago, tapioca,* and *arrowroot.* All food containing much starch should be well cooked, otherwise the little cells enclosing the granules of starch are not broken through. In order for the starch to be digested, and to become of use in the body, the granules must be liberated, so that certain of the digestive fluids may come in contact with, and modify them (*page 15*).

Rice contains about 76 per cent. of starch, and 7 per cent. of gluten.

Potatoes contain 75 per cent. of water, and 15 to 16 per cent. of starch, with about 2 per cent. of nitrogenous matter. Their cheapness strongly recommends them as food to the poorer classes; but unless they are **mixed** with some other substance rich in **nitrogenous matter**, they are incapable of supporting vigorous life. Their value as food may be very considerably increased by combining them with milk, butter, or fat bacon.

Artichokes contain starch, but even more water than the potato; they are, therefore, less nourishing.

Neither arrowroot, nor any other kind of starch, can furnish materials for the construction or repair of muscles; it, however, ranks next to oil and fat as a heat-producer.

All vegetable foods contain starch, and special attention is only called to those mentioned above, because they contain a larger quantity of starch in proportion to other matters; for example:—wheat flour contains 66 per cent. of starch, oatmeal 59 per cent., barley flour 69 per cent., rye meal 70 per cent., Indian corn meal 65 per cent., peas 52 per cent., and haricot beans 53 per cent.

Vegetables, such as *carrots*, *parsnips*, *turnips*, *beetroot*, *cabbage*, and *cauliflower*, resemble each other much in composition and nutritive qualities. All alike contain a large per-centage of water, cellulose, and woody fibre, which gives them a bulky character. Their value depends mainly upon the mineral matter which they contain, and, in consequence of which, they possess anti-scorbutic properties. Owing to the large amount of water which carrots, parsnips, and turnips contain, they are well adapted for admixture with salt meats.

The *beetroot* contains a large amount of sugar, and therefore ranks above turnips and carrots as food.

Onions, *leeks*, and *garlic*, are mainly useful in giving flavour to otherwise tasteless and insipid foods. The strong smell and taste

is due to a volatile oil. If the water in which the onions are cooking is thrown away, and renewed from time to time, much of the indigestible and strong-smelling qualities are removed.

Marrows, *cucumbers*, and *pumpkins*, all contain a very large percentage of water. They are all most wholesome, and easily digested when fresh cut.

Watercress and *lettuce* are particularly anti-scorbutic. The latter contains a sedative principle which produces a very marked effect upon some.

Fruit, when fresh, contains much water, and only **little nutritive matter.** Its value depends upon the aperient and anti-scorbutic actions which it possesses. These properties are due to the action of the **acid juices** which are present in all fruits.

The **skins of fruit** should never be eaten, as they are most indigestible. Irritation, and even fatal inflammation, of the intestines may be produced by the tough skins of fruits.

Only **ripe fruit** should be taken raw. **Unripe fruit** should always be cooked before it is eaten. The acid juices present in unripe fruits renders them liable to cause diarrhœa, and other derangements of the digestive system.

Fruit is one of the most healthy of foods, and ought to form a much larger proportion of our daily diet than is usual. When in season, the more succulent fruits are strongly recommended as substitutes for doubtful water, or alcoholic drinks.

Preserved fruits contained in tins are open to objection, for frequently the acid juices act upon the lead solder used in closing the tin, and produce poisonous salts of lead. Fruit should never be stewed in copper or brass vessels, for, in such cases, poisonous salts of copper may be produced.

The object of the foregoing lines has been to give the reader a general idea of the kinds of food stuffs, and the foods in which they occur in the largest proportion. We shall have next to learn something of the condiments and spices used with true food, and something of the preparation of food.

CHAPTER VIII.

CONDIMENTS.

What is a Condiment?—Difference between Condiments and Spices.—Mustard.—Horse-radish.—Pepper.—Cayenne Pepper.—Curry Powder.—Parsley.—Mint.—Thyme.—Capers, and their use.

CONDIMENTS are those products of vegetable origin which are used to **flavour** many foods, and render them more palatable. They increase the appetite by the flavour they bestow upon the food, and aid digestion by stimulating the digestive organs. When properly used, they render food generally more agreeable to the senses, and hence more digestible. They are usually taken with *salt dishes*, whilst *spices* are used in the preparation of *sweet food* for the table. But it is difficult in many cases to draw a hard and fast line, or to say which shall be called a spice or which a condiment.

Mustard, horse-radish, pepper, curry, parsley, mint, thyme, and **capers**, all rank as condiments.

Mustard is prepared from the seeds of *Brassica nigra* or *Brassica alba*, which yield the black and white mustards respectively. Mustard has little or no odour when dry, but when moist exhales a most pungent odour. This pungent character is due to the liberation of the **essential oil** which is developed by the addition of water. This important substance is rendered inactive by **boiling water** for the table, therefore mustard should be prepared with **warm** water only. It acts, when taken with food, as a stimulant, promoting the secretion of gastric and other juices, and therefore accelerates digestion. Doubtless, it is more useful in hot than in cold countries. The need of a stimulant to rouse the stomach is far greater in the former than in the latter. When indulged in frequently in large quantities, it produces liver diseases.

Horse-radish contains a pungent essential oil closely allied, if not identical, with that which is formed in mustard. It acts like mustard, stimulating the flow of saliva and other digestive fluids.

The essential oil is volatile; the root should, therefore, be kept by thrusting it in moist earth, and should not be allowed to become dry.

Pepper is the fruit of a climbing plant largely grown in the East and West Indies. It contains an active volatile oil, and a nitrogenous substance known as piperin. Pepper is useful when eaten with foods of an indigestible nature, and with those which, like cabbage, produce flatulence. It is somewhat stimulating and heating in its nature, and is most useful in hot countries, but should be used only in small quantities in cold climates.

Cayenne Pepper is more stimulating and heating in its action than ordinary pepper. The small pods from which it is prepared are known as chillies. The red powder sold as cayenne pepper is frequently adulterated with *rice*, *salt*, *corn-meal*, *red ocre*, *red lead*, and *brick dust*.

Curry powder is prepared from *allspice*, *cloves*, *black pepper*, *cayenne*, *ginger*, *cumin*, *turmeric*, *coriander*, and *fenugreek*. It is a hot stimulating condiment, largely used in India and other hot countries. The sluggish action of the digestive organs which is induced by the climate is counteracted, and their activity increased by the use of curry.

Parsley, *mint*, *thyme*, *capers*, etc., are vegetable products used to flavour dishes, and increase their digestibility.

CHAPTER IX.
SPICES.

Spices and their Use.—Examples of Spices.—Active Properties and Value of the following :—Ginger, Cinnamon, Cloves, Allspice, Nutmeg, Mace, Flavourers, Bitters, Vinegar.—Adulteration of Vinegar.—The Acids of Fruits.

SPICES are used generally in the preparation of *sweet foods* for the table, they stimulate the secretion of saliva and other digestive fluids, and hence aid digestion. We have good examples of such substances in **ginger, cinnamon, cloves, allspice, nutmegs, mace**, and **caraway**.

Ginger is the rhizome, or underground stem, of a plant which grows in the East and West Indies. It acts as an anti-spasmodic, and is very useful in some cases of intestinal spasms, or diarrhœa.

Cinnamon is the inner bark of a kind of laurel which grows in Brazil and the East Indies. It contains an essential oil, which gives it an agreeable odour and pleasant taste. Taken with food, it is highly stimulating, and assists digestion.

Cloves are the dried flower-buds of a kind of laurel imported from the West Indies and Zanzibar. They contain an aromatic oil which is often used to impart a pleasant flavouring to apple pies and puddings.

Allspice, or Jamaica pepper, is obtained from a kind of myrtle growing in Jamaica. It imparts a mild and agreeable flavour to many dishes. The active aromatic oil to which these properties are due is allied to that which is found in cloves.

Nutmegs are the seeds of an evergreen which grows in New Guinea, etc. They are soothing in their action, and appear to be of use especially in cases of loss of appetite.

Mace is the covering of the shell which encloses the nutmeg. It has a hot and somewhat bitter taste, but an agreeable aromatic odour, which renders it slightly stimulating in its action.

Flavourers are those substances which are obtained from the seeds, fruits, and other parts of plants. They are used to impart a flavour to food in the process of cooking, or from them cordials and fruit drinks are prepared.

Bitters are prepared from infusions of *orange peel*, *columba root*, etc. They are stimulating in their action, and are used to produce an artificial appetite. To these stimulators for a time the stomach may respond; but, if continually used, the dose must be increased to obtain the same result, or the stomach refuses to do its work.

We cannot dismiss this part of our subject of food, without saying a little about the **acids** taken with food.

Vinegar, when pure, contains about 5 per cent. of glacial acetic acid, with much water, and varying amounts of colouring matter.

Vinegar is largely used as a condiment, and in the preparation of pickles and sauces. It acts as an agreeable stimulant to the stomach, and is very useful when taken with foods, such as veal, of a viscid gelatinous character. The decomposition of animal and vegetable substances is checked by vinegar; it enables us, therefore, to keep mackerel, salmon, herring, and other flesh, in warm weather. Taken with vegetables, such as spinach, cabbage, and with salads, it makes the dish more tasty, and checks flatulence. Thin people who wish to increase their weight should not indulge in its use. Those who suffer from gout, costiveness, or red gravel, are recommended to avoid it. Vinegar should not be given to young children, and especially those inclined to rickets.

Unfortunately, vinegar is frequently **adulterated with sulphuric acid.** This substance is apt to produce most painful irritation of the bowels accompanied by diarrhœa, and the continued use of vinegar so adulterated may even be attended with fatal results. The presence or absence of sulphuric acid in a given sample of vinegar may be easily ascertained. Add to the suspected specimen a few drops of *barium chloride*, if a white powder falls to the bottom, the vinegar should be rejected as containing sulphuric acid. The following less harmful substances are used also as adulterants—*water*, *burnt sugar*, *spirits of nitre*, *pure acetic acid*, *fusel oil*, *malt extract*, and *chillies.*

Vinegar is largely used in the preparation of **pickles**, and those pickles which have a **bright green** and somewhat natural colour should be regarded with suspicion. Frequently, such colour is due to the presence of **injurious metallic salts**, which have been produced by the action of the vinegar on the metal vessels in which they have been prepared.

The acids of vegetables and fruits assist digestion, stimulating the secretion of the digestive fluids, and acting themselves as solvents on the food. But their own nutritive value is very small. The most important of these acids are—*citric of lemons*, *tartaric of grapes*, *malic of apples and pears*, and *oxalic of garden rhubarb.*

CHAPTER X.

MILK AS FOOD.

Variation in Quantity of Food Required.—A Perfect Food.—Composition of Milk.—Water, etc., of Milk.—Milk only Model Food when all its Components Present.—Condensed Milk and its Value as Food.

THE forms of food are **water, nitrogenous, carbonaceous** (*carbohydrates* and *oleaginous* or *fatty*), and **saline.** The **quantity** of the various elements **of food** which is required depends on the nature of the **occupation,** amount of **work** performed, **climate,** and doubtless on **constitutional peculiarities** of the individual.

A perfect food is one which contains some one or more substances belonging to each of the four classes of food stuffs. Many young animals are wholly nourished by *milk*, which consists of *water*, *fat* or *cream*, *milk sugar*, *curd* or *casein*, and *ash.* As milk supplies all the matter necessary for health and growth in the earlier periods of life, we may regard it as a model and typical food. But we must bear in mind, that as the body develops, and the conditions of life become more or less modified, we cannot expect that the same proportions of the different materials are either necessary or good.

The composition of milk varies in different animals, as will be seen from the following table:—

Components of Milk.	Cow.	Ewe.	Goat.	Human.
Casein and Albumen ...	*4·48*	*5·90*	*4·4*	*1·8*
Milk-fat	*3·20*	*5·20*	*4·2*	*2·3*
Milk-sugar	*4·75*	*4·00*	*4·1*	*6·7*
Mineral matter	*·60*	*·70*	*·7*	*·2*
Water	*86·97*	*84·20*	*86·6*	*89·0*
	100·00	*100·00*	*100·0*	*100·0*

Water constitutes from 85 to 86 per cent. of cow's milk, and is the medium in which all the solids are dissolved or suspended.

The **oil or cream** which rises to the surface of the milk when it is allowed to stand for a time, helps to build up the fat of the body, and, if required, it is used to produce heat.

The milk sugar or lactose changes into *lactic acid* when the milk becomes sour, so that which makes the fresh milk *sweet*, will, after undergoing a change, cause the milk to become *sour*. This substance may be used to keep up the heat of the body, or to build up fat. The souring of milk may be retarded by adding a little carbonate of soda.

The curd or casein is that part of milk from which cheese is prepared. It is rich in *nitrogen*, and is used in the body to build up muscle and repair the waste of nitrogenous matters. Milk also contains dissolved albumen.

The mineral matters may be obtained from the milk by first driving away all the water in the form of steam by boiling, and then burning the white cake of fat and curd which is left. There will remain in the vessel a thin layer of ash only. This mineral matter furnishes salts to the blood, which helps to build up the bones, etc.

It is essential that every portion of the milk be present. Then it is a *perfect, natural, and model food.* By the re-construction of the component substances of milk in the body, the blood, bone, flesh, fat, etc., of the young animal is formed.

Cream and water alone would not support life. An animal fed upon such would lose flesh and become thin, because of the absence of nitrogenous matter. Ultimately, such an animal would die from "*nitrogen starvation.*" If an animal were, on the other hand, fed upon **pure water, cream, and curd**, then the bones would not be properly formed, because the substances necessary for their construction are wanting in such a mixture.

A good wholesome and serviceable drink may be prepared by adding seltzer, soda, or lime-water to milk.

Condensed milk is milk which has been deprived of a large part of its water, and some of the fat, and to which has been added about one-third of its weight of sugar. It cannot be regarded as a

model food in the same way as pure milk, for the proportion of heat-giving and nitrogenous matters are too high. Children fed upon it fatten rapidly; but, owing to the comparatively small quantity of saline matter present, the bones are only imperfectly formed. Generally a weak state is produced, and a predisposition to disease. The use of condensed milk for children is not to be advocated.

CHAPTER XI.

AMOUNT AND KIND OF FOOD REQUIRED.

Amount of Food required Daily.—Variations in the Quantity.—Nursed Diet.—Proportion of Food Stuffs which should be Present in well-balanced Diet.—Actual Food Required.—Unbalanced Diet.—A Day's Ration.

THE **amount of food required daily** has formed the subject of repeated experiments. It has been demonstrated that the *quantity* required varies with the **quality** and condition of the food taken, as well as with the **age, sex, constitution, habits of life, amount of work,** and **climate.** Now, as there are so many causes at work tending to produce variations in the amount required, it becomes difficult to lay down a rigid rule as to how much food should be taken in twenty-four hours. The average daily diet of a man weighing 154 lbs., under ordinary conditions, should contain, according to Church, the following proportions of the different food substances:—

Food Stuffs.	In 100 parts.	Each 24 hours.		
		Lbs.	Ozs.	Grains.
Water	*81·5*	*5*	*8*	*320*
Albuminoids, or flesh-formers... ...	*3·9*	*0*	*4*	*110*
Starch and Sugar	*10·6*	*0*	*11*	*178*
Fat	*3·0*	*0*	*3*	*337*
Common Salt	*0·7*	*0*	*0*	*325*
Phosphates, Potash, Salt, etc.	*0·3*	*0*	*0*	*170*

Such a daily ration would, under ordinary circumstances, simply maintain his body without loss or gain of weight.

The previous table gives us some idea of the relationship which the actual **food-stuffs** should bear to each other in a **well-balanced diet.** But we take our food in the form of a vast number of animal and vegetable products, which contain many substances in addition to water, albuminoids, sugar, starch, fat, and salts. Most of these additional substances give bulk to the food, but are of little or no nutritive value to the body, and are, in fact, cast off as waste products from the digestive canal.

From experiment and observation we have learnt that the **best proportion in a mixed diet** would embrace *twenty-two parts of nitrogenous matter, nine parts of fat, and sixty-nine parts of sugar and starch by weight.*

The foods classed as nitrogenous contain more flesh-forming, in proportion to fat and heat-producing matter, than is required. In other words, they contain an excess of nitrogenous matter. Those which have been classed as carbonaceous contain an excess of starch, sugar, or fat in proportion to nitrogenous matter. They, therefore, are, equally with the purely nitrogenous foods, unable to support life when taken alone for any length of time. The rich as a class suffer most from excessive nitrogenous feeding. In some it produces gouty diseases, in others dyspepsia, and in others diarrhœa. Many of the diseases of the poor are traceable to unwholesome food. Some also are due to continued use of large quantities of carbonaceous foods, such as rice, potatoes, and bread, which are all poor in nitrogen. When little nitrogenous food is taken, the nutrition of the muscles is checked, and they are rendered incapable of prolonged action. Under such conditions the body becomes stout, the breath short, and the mind inactive, and a general weakness and predisposition to disease is induced.

It becomes necessary to consider next the proportion of **actual foods** which should be taken in twenty-four hours. The British soldier consumes about ¾ lbs. of meat, 1½ lbs. of bread, and 1 lb. of

vegetables daily. Here, the amount of flesh is not large, and, in cases of very hard work, may be slightly increased.

In cold climates, a largely increased amount of fatty matter is required. Sir John Ross states that the daily ration of natives of the Arctic regions is 20 lbs. of flesh and blubber.

An **unbalanced diet** is one which contains an excessive amount of some one or more of the substances required as food. Such a diet is not only expensive, but it is unwholesome, for it throws a large amount of unnecessary work upon the digestive organs. Extra work also devolves upon the excreting organs in getting rid of it. When such is taken, partial decomposition is often set up in the intestines—this leads to the production of fætid gases.

It is highly important, then, that the diet should be mixed—such is best suited for the healthy frame.

A good and yet cheap mixed daily diet, which contains some of all the substances required by the healthy body, is that proposed by Church.

A Day's Ration.

Bread	18 ozs.	Altogether, these quantities will contain about 1 lb 5¾ ozs. of dry substances, though they weigh in all 6 lbs. 14½ ozs.
Butter	1 „	
Milk	4 „	
Bacon	2 „	
Potatoes	8 „	
Cabbage	6 „	
Cheese	3½ „	
Sugar	1 „	
Salt	0¾ „	
Water alone, and in tea, coffee, and beer	66¼ „	

CHAPTER XII.

COOKING.

The Advantages of Cooking Food.—Roasting.—Broiling.—Grilling.—Frying.

THE **Preparation of Food.** We have seen that food is necessary for the health and well-being of the body. Between man on the one hand, and his food on the other, stands the cook, whose object it should be to so prepare the food that it may perform its nourishing work in the most economical manner.

The advantages of **good cooking** may be summed up as follows:—

1. **Food is, as a rule, more digestible.** Flesh is more nutritious when eaten raw, but less digestible than when well cooked.

2. **It is rendered more attractive** both to the sense of taste and smell.

3. **A variety is obtained.** Even by preparing the same actual food in different ways, that change of diet may be obtained, which is so essential to health. Monotony of diet should be avoided, especially for the young. The materials of the principal dish should be changed often by different modes of cooking, or otherwise. Most persons are aware of the pleasure derived from, and the greater acceptability of, frequently changed foods. The gratification of the appetite, by indulging in variety, conduces to health; and it is worthy of note, that positive distaste and disgust is frequently induced by the constant use of the same kind of food.

4. **The food is cleaned;** the waste and useless parts are removed and cast aside. During the preliminary process of cleaning vegetables, parasites are removed.

5. **Parasites are destroyed** by heat during cooking. Pork and ham should be thoroughly cooked to avoid the risk of tape-worms, and other parasites.

In cooking meat, we must always have one of two objects in

view, and we must employ different means as we aim at one or the other. We wish either to get the flavour and nourishment *out of the meat*, or we wish to *keep them in*. When we roast meat, or boil a joint, we wish to retain the nutritive matter. But when we prepare soup, we wish to extract it.

Albumen is **coagulated** by heat, that is, it becomes softly solid when subjected to the temperature of boiling water. This fact is made familiar to all in the case of a plain boiled egg. Meat contains albumen. In cooking joints for the table, by roasting or boiling, our first object is to adopt such a course that a **thin crust of solidified albumen** will be formed on the outside of the meat. Our second object should be to take such other means as will prevent the spread of this coagulation through the entire joint.

It is important to remember that fats are not so easy of digestion when they have been subject to heat.

The meat should be allowed to hang until the fibres lose their stiffness, that is, until after the *rigor mortis* has passed away, or the joint will not be tender when cooked.

Meat which has been allowed to *hang* for a long time is unwholesome; no food which has once undergone putrification can possibly be regarded as healthy. The practice of hanging game is bad.

We are apt, often, to spoil animal food by overcooking, and vegetable food by undercooking. As a rule, more skill and trouble is required in cooking vegetables than animal food.

The processes employed in fitting food for man come under the head of—

Roasting,	**Broiling,**
Frying,	**Baking,**
Boiling,	**Stewing.**

I.—**Roasting,** in some form, was doubtless one of the earliest methods adopted by man for the preparation of his food. Among

many savage and semi-civilised races at the present time, we find that it is the only form of cooking practiced. Boiling, stewing, and other modes of preparing food are more complicated, and require considerable skill. To prepare food in these ways, vessels which may be subjected to a great amount of heat are required.

In roasting meat, the experienced cook tells us that the heat should be greatest at first. This, he says, may be attained by placing the joint near the fire at first, but not so near as to scorch or burn it, and afterwards increasing the distance between it and the fire—Why? The object of this process is to produce at first a coat of coagulated or consolidated albumen on the *outside*, which will seal up the juices within the joint. Thus, the escape of much nutritive matter is prevented. Now, if the great heat be continued, the consolidation increases and penetrates the whole joint, which, in consequence, becomes tough and indigestible. If the heat at first is only slight, then much of the nutritive matter which should be sealed up within the joint escapes in the form of gravy. If the directions as given above by the good cook are followed, we have a joint prepared for the table with a crust on the outside, whilst within, the meat is both delicately flavoured and highly nutritive. The internal part is lighter and more easily digested, and is best fitted for invalids or those with weak digestion. The browned outside is comparatively difficult to digest, and should only be partaken of by those who have strong digestive organs. In other words, good roasting consists in thorough and gradual cooking, by which the joint is neither heated too slowly, and so withered up, nor too rapidly, and so burnt.

Of course no amount of good cooking can make a tough piece of meat, which is poor in nutritive matter, either tender or nourishing. On the other hand, bad cooking may spoil the best joint, and result in the loss of much of the nutritive matter—rendering the meat tough and difficult to digest. Unfortunately, this experience is too common, and it will, doubtless, recall unpleasant recollections to many.

II.—**Broiling and grilling** are really only modified forms of roasting, and may be regarded as roasting on a small scale. By this means chops and steaks are better prepared for the table than by frying. As before mentioned the heat should be strong at first, if we wish to retain within the meat the maximum amount of nutritive matter. In these cases a fire of red hot, glowing coals, as free as possible from ashes, dust, and smoke, is the best. Such fires as these are found in the best grill-rooms of our large towns.

III.—**Frying**, although regarded as one of the easiest, is one of the worst modes of preparing food. Often the fire is too weak, and the steak or chop is *stewed* in fat and the juices extracted. On the other hand, the fire may be too strong, and the meat is scorched and not cooked. Remember always that frying renders fat difficult of digestion and unwholesome.

A common mistake is that of only using a little fat; enough should always be used to partially or wholly cover the meat. The food thus prepared retains its nutriment; it is of good flavour, and has not that unpleasant fatty taste, which is the result of using a little fat only. Lard is far better to use generally for frying than the common town butter. Meat prepared by frying is not good for those with weak digestions. When we cook a steak on a gridiron our object is to keep in all the nutritive matter. We must, therefore, take care to have a hot clear fire, which will quickly form the outside coat of solidified albumen.

CHAPTER XIII.

COOKING.—Continued.

Boiling.—Re-boiling.—How to Cook Potatoes.—Preparation of Soup.—Unwholesome Dishes.

BOILING.—The object may be to prepare soup or a good dish of solid meat. Now it must be borne in mind that in no case can the same pot simultaneously furnish us with a well-cooked

joint and nutritious soup. In other words, the meat when placed in the pan contains a certain amount of nutritive matter, which no amount of boiling will actually increase or decrease, and which may either be retained in the meat or extracted by the liquid. The processes employed in the two cases are essentially different, and we must either sacrifice the soup to the meat or the meat to the soup.

To so cook meat by boiling, that it may return the maximum amount of nutritive matter, it is necessary to plunge it into boiling water. Why? The boiling water causes a crust of hardened albumen to be formed on the outside, which seals up the nutritive matter within. If we allow the saucepan to remain on the fire, the hardening process will go deeper and deeper into the meat, till at last a tough and indigestible joint is produced for the table. As soon as the water, with the joint in it, has boiled for a few minutes, it should be drawn aside and allowed to *simmer*, not to *boil*, until the meat is sufficiently cooked. A coat of coagulated albumen is produced by plunging the meat in the boiling water and allowing it to boil for a few minutes. This closes up the pores and prevents the escape of gravy and nourishment, while the simmering cooks the meat, and a tender, nutritive joint is the result.

In re-boiling, it is necessary to adopt special means to prevent the escape of nutriment. In the case of a ham, for example, in simple boiling, the hard, thick skin prevents the juices from passing into the water. Should it be underdone, and need re-boiling, something must now be provided to take the place of the skin which has been cut off, and prevent the escape of juices into the water. This result is attained by coating the ham with a thin layer of paste. In this way the joint may be thoroughly cooked, and the original flavour retained.

As boiling is so well adapted, and is in such general use for vegetables, it will not be out of place to say something here of their preparation.

By boiling, vegetables are, as a rule, deprived of much of their air, their juices are often considerably changed, and their starch cells are burst, and insoluble components modified and rendered more digestible. Perhaps we may learn more of this subject by taking potatoes as our type—learning what directions the good cook gives as to their preparation and cooking, and explaining as far as possible the why and wherefore.

1. *Potatoes are best boiled in their skins.* Why? Because the skins keep the nutritive matter in. A layer of nitrogenous matter exists beneath the skin; this is lost if the potatoes are pared before cooking.

2. *Do not let them soak in water for a long time.* Why? Because nutritive matter is dissolved out by the water.

3. *Wash them in cold water, not in hot.* Why? Because hot water dissolves out nutritive matter more quickly than cold.

4. *Old potatoes may be put on in cold water—young ones in hot.* Why? Because the slow and gradual cooking, which is necessary in the former case, will reduce the young ones to a soft and pulpy mass.

5. *All potatoes cooked at the same time should be about the same size and age.* Why? In order that they may be all equally well done at the same time—not some hard, others soft and watery.

6. *When they are sufficiently cooked, the water should be poured off; they may then be set near the fire again, the lid being tilted on one side.* Why? Because we wish the potatoes to dry off, in order that they may be presented to the table in a mealy, not watery, form.

Potatoes are far better steamed than boiled. For those with delicate stomachs, potatoes should be always served mashed, as it is a common mistake to suppose them easy of digestion, unless well masticated. Underdone potatoes are very objectionable, as they are exceedingly indigestible.

Soup.—In the preparation of soup our object is to *withdraw the juices from the meat as much as possible.* Therefore, we cut up the meat and plunge the pieces into *cold water*, and allow it to simmer for hours. No coating of solid albumen is formed in this case; but the juices of the meat slowly pass into the water, transforming it into soup.

Unhealthy dishes and practices.—There are many dishes which, owing to their stimulating or indigestible nature, are the cause of disease. Amongst these may be enumerated—pork in most forms, boiled crabs and lobsters, lobster salad, boiled beef, hard-boiled eggs, cucumbers, rich gravies, rich pastry, and sweet dishes of many kinds.

Copper vessels, used for any purposes connected with the preparation of food, should be kept clean and dry; for damp and dirt that may remain adherent to them produces poisonous salts of the metal. Fruits and vegetables should not be prepared in copper vessels. Pickles with a bright green colour should be regarded with suspicion, for they may contain poisonous salts of copper.

The acids of preserved meats and fruits act upon the lead used as solder, and the metal encasing them, and may give rise to lead colic. No tinned preserved fruit, fish, or flesh, should be eaten after it has been exposed to the air for more than a day: the oxygen of the air assists the acid juices in acting upon the metal; hence, the chances of poisoning are increased, when potted foods which have been exposed to the air are taken as food.

Relative digestibility of foods.—It has been observed that the mode of cooking has a marked effect upon the digestibility of any food, and, it is worthy of note, that the same substance, cooked in various ways, varies in its digestibility.

Many experiments have been made by physiologists with the view of ascertaining the rate at which different foods are digested. Those from which we have probably learnt most were performed by Dr. Beaumont, who had in his service a Canadian, Alexis

St. Martin, who, at the age of nineteen, had an opening made into his stomach, the result of a bullet wound. This opening was covered only by a valvular fold of skin. Through it, therefore, Dr. Beaumont was able to introduce various articles of food, and other objects, into the stomach. A most valuable series of careful observations were in this way carried out, the results of which are given in a table below.

Relative Digestibility of Vegetable Substances.

Article of Diet.	How Prepared.	Time of Chymification. H. M.
Rice	Boiled...	1 · 0
Apples (sweet and mellow) ...	Raw	1 · 30
Sago	Boiled... ...	1 · 45
Tapioca	Boiled... ...	2 · 0
Barley	Boiled... ...	2 · 0
Apples (sour and mellow)	Raw	2 · 0
Cabbage with vinegar ...	Raw	2 · 0
Beans	Boiled...	2 · 30
Sponge Cake	Baked...	2 · 30
Parsnips	Boiled...	2 · 30
Potatoes	Roasted	2 · 30
Potatoes	Baked...	2 · 33
Apple Dumplings	Boiled...	3 · 0
Indian Corn Bread	Baked...	3 · 15
Carrots	Boiled...	3 · 15
Wheaten Bread	Baked...	3 · 30
Potatoes	Boiled...	3 · 30
Turnips...	Boiled...	3 · 30
Beets	Boiled...	3 · 45
Cabbage	Boiled...	4 · 0

Relative Digestibility of Animal Substances.

Articles of Diet.	How Cooked.	Time of Chymification.
		H. · M.
Pigs feet	Boiled...	1 · 0
Tripe	Boiled...	1 · 0
Eggs (whipped)	Raw	1 · 30
Salmon trout	Boiled...	1 · 30
Venison steak	Broiled	1 · 30
Brains	Boiled...	1 · 45
Ox liver...	Broiled	2 · 0
Cod-fish (cured dry)	Boiled...	2 · 0
Eggs	Roasted	2 · 15
Turkey	Boiled...	2 · 25
Gelatine...	Boiled...	2 · 30
Goose	Roasted	2 · 30
Sucking pig	Roasted	2 · 30
Lamb	Broiled	2 · 30
Chicken...	Fricassee	2 · 45
Beef	Boiled...	2 · 45
Beef	Roasted	3 · 0
Mutton	Boiled...	3 · 0
Mutton	Roasted	3 · 15
Oyster	Stewed	3 · 30
Cheese	Raw	3 · 30
Eggs	Hard Boiled	3 · 30
Eggs	Fried	3 · 30
Fowls	Boiled...	4 · 0
Fowls	Roasted	4 · 0
Duck	Roasted	4 · 0
Pork	Roasted	5 · 15
Tendon or *gristle*	Boiled...	5 · 30

CHAPTER XIV.

EATING.

How Much to Eat.—When to Eat.—How to Eat.—Rules about Eating.—Economy in Food.—How to Increase the Weight.—Growing Fat.—Reducing the Weight.

HOW **much to eat.**—A healthy, full-grown Englishman, doing a fair day's work, requires in twenty-four hours (*see table page 36*) about *four and a half ounces of* **dry nitrogenous matter,** *three ounces of* **fatty** and *twelve ounces of* **starchy** and **sugary food,** as well as *one ounce of* **saline food.** In order therefore to retain his full health and strength, and not to lose weight, he must eat and thoroughly digest daily rather more than a pound of fresh meat, two pounds each of bread and potatoes or other starchy food, and about a quarter of a pound of butter or fat.

The amount of work performed, the climate, and peculiarities in the organization of the individual will cause variations in the numbers given above. As a rule, adult women require only about nine-tenths of the food required by men, but here again variations occur which depend upon the condition of the body.

About twice as much food is required during very hard work as in idleness, and about one-half as much for ordinary work. For spurts of exceedingly hard work, during which it is necessary to supply the body with much nutriment which may be digested, it is desirable that the diet should contain a large amount of meat.

The diet, in all cases, must be modified according to the work. That which will suffice during idleness will not be sufficient under stress of labour.

All people who wish to preserve their digestion and have a healthy appetite for an ensuing meal, should not continue to eat after they feel satisfied, and they should not take food between meals.

When to eat.—Meals should be taken at **regular hours,** for the organs perform their functions much more satisfactorily when

regularity is observed. Regularity, both as to the time at which food is taken and the quantity taken, is of the very greatest importance.

A proper time should be allowed to intervene between meals. The common practice of eating between meals, by which means fresh food is introduced into and mixed with that which is partially digested, is very injurious. Too long a time should not be allowed to elapse between meals, for the exhaustion which is thus produced interferes considerably with digestion.

The frequency with which food should be taken depends upon many conditions. Three meals a day are usually regarded as sufficient for the healthy adult, but four may be necessary in cases of hard work. Light nutritious food should be taken for breakfast before the work of the day is commenced. After the long night fast the desire for simple food is great.

The often-repeated question whether mid-day or evening dinner is most conducive to health, must be answered by the circumstances and nature of the occupation of the individual. It is most important that the principal meal of the day should be taken leisurely, and at such a time that no severe mental or muscular work has to be performed immediately after it. For most professionable men and clerks an early light luncheon, and dinner at five or six, after the work of the day is over, is to be preferred. The luncheon should be a light and not a full meal. It then becomes rather an aid to either physical or mental work.

How to eat.—It is necessary that the digestive juices should be brought in close contact with all parts of the food. This can only be done when the whole is thoroughly mechanically reduced. Food, therefore, should be eaten slowly and chewed well, and not swallowed whole as is too often the case. The mind should be free and undisturbed—thought and care of business, etc., should be dismissed if we wish to derive the largest amount of good from the meal. Cheerfulness of mind and conversation is a great aid to good digestion.

It is a bad plan to drink a large quantity of liquid during a meal,

for the digestive fluids are thereby considerably diluted, and their activity partially destroyed. Tea should never be taken as a beverage when much food is eaten, for the tannin, which it usually contains, acts upon the stomach and the food, so as to impede digestion.

Those who wish to live long and escape indigestion, low spirits, dyspepsia, and its host of accompanying evils, will take to heart the following simple rules respecting eating:—

1. *Take ordinarily only three meals a day.*
2. *Let the meals be regularly taken.*
3. *Take no food between meals.*
4. *Never eat so much as to produce a feeling of oppression in the region of the stomach.*
5. *Cut your food as small as possible.*
6. *Chew your food thoroughly, and do not swallow it whole.*
7. *Eat slowly, and spend from half-an-hour to three-quarters at each meal.*
8. *Do not begin work within half-an-hour after eating.*
9. *Do not indulge in alcoholic drinks and strong tea.*

Economy in food.—Butchers' meat is expensive, and hard work may be performed and perfect health maintained without it. Taken once a day, owing to its composition, it forms an agreeable and valuable variety. The place of meat may be supplied to a very considerable extent by well-cooked whole-wheat-flour, pea-meal, oatmeal, and maize. With these, and milk, butter, fat, rice, potatoes, eggs, fresh vegetables, and fruit, people may be nourished at a small cost. Where hard work has to be performed, nothing exceeds in nutritive value fresh cooked oatmeal and milk.

It is the quantity and quality of the food taken, and the amount of work performed, or exercise taken, as well as the individual peculiarities, which make us fat or lean.

Those who wish to **increase their weight** may eat some of any of the fat-producing foods, such as—

1. **Fatty foods**—*fat meat*, *soup*, *fish*, *butter*, *milk*, *cream*, and *eggs*.

2. **Starchy foods**—*bread, potatoes, cakes, arrowroot, rice,* and *tapioca.*
3. **Saccharine foods**—*apples, peaches, beetroot, carrots,* and *parsnips.*
4. **Sweet foods**—*sweetened jellies, custards, blanc-mange,* and *honey.*

They may drink *chocolate, milk, coffee,* and *tea in small quantities.* **Should avoid taking** all *acid fruits or vegetables, pickles,* and *salted flesh* of all kinds, *sour wines,* and *vinegar.*

It is necessary for those who wish **to reduce their weight** to modify these directions as far as actual foods are concerned. The quantity taken under such circumstances must be limited, and the amount of exercise should be considerably increased. Three meals a day should be taken, and fat people should not stay at the table to satisfy their appetites, but should leave off eating as if more could be taken.

Those who wish to reduce their weight should avoid taking *wheaten bread, rice, sago, arrowroot, tapioca, fruits, potatoes, starchy vegetables,* all *sweet dishes, milk,* and all *sweet wines.*

They may take *butchers' meat* of all kinds, fresh and salted *fish, game* and *poultry,* which should be as lean as possible; *eggs, spinach, watercress, salad* prepared with vinegar; *tea, coffee, sour wines,* and *unsweetened drinks.*

Diet in youth.—At this period of life the food should be abundant, plain, nourishing, and **not** stimulating. Activity being the natural condition of the young, they require food at frequent intervals, and cannot do without food for so long as adults. The meals should be taken four or five times a day, and should not include highly-seasoned dishes, or those prepared with spices and condiments. Tea, ham, and smoked foods are not good, and should be avoided as unwholesome.

CHAPTER XV.

KINDS OF WATER.

Quantity of Water Required.—Sources of Water.—Pure Water.—Hard Water.—London Water.—Temporarily Hard Water.—Permanently Hard Water.—Soft Water.

WATER ranks next to air as one of the necessities of life. Man may live for some days without solid food, for hours without water, but only for a few seconds without air. This liquid is an **absolute necessity,** deprived of which, we must die in a few hours. Yet such is the influence of our boasted civilization, that it has become an article of sale among us; doubtless, such is the nature of our crowded life in cities, that we must pay for the privilege of having fresh water brought to our houses; yet, how much better would it be were it provided at the common expense for the good of all. As matters now stand, in most of our large towns and cities, its sale is a monopoly in the hands of a few, who reap enormous profits by supplying us with this necessity, often in a very impure form; fortunately, there are notable exceptions, where fresh pure water is supplied at the general expense to the community; but, in this great London—the city of the world—probably no existing evil requires more urgent attention, and immediate redress, than that of our water supply.

The total average daily delivery of water by the various water companies in London reaches nearly 120,000,000 gallons.

Water may be regarded as one of the chief factors regulating the health and well-being of the people. Upon its character, supply, and use, very largely depend the amount of sickness and the death rate. So common is it, and we are generally so well supplied, that we are apt to think little of it, and to forget how necessary it is to healthy life. Of its uses, probably the *first* to suggest themselves to most of us are those of cooking and cleansing in all its branches; but we generally forget that it is **absolutely a food.**

L Winslow

Quantity of water required.—Watcr makes up rather more than three-fourths of the entire weight of the body. The body of a man weighing 154 lbs. contains about 109 lbs. of water. An average-sized **man loses**, by means of the skin, lungs, and kidneys, from **80 to 100 ounces** of water **in 24 hours.** Thc water thus lost in perspiration, breath, and urine, has to be replaced from without. To make good this loss, we must take from $3\frac{1}{2}$ to 5 pints daily. Now all solid food contains water; and about one-third of the total amount required is taken in such food as meat, potatoes, etc. Two-thirds therefore, or from $2\frac{1}{2}$ to $3\frac{1}{2}$ pints, must be taken in the form of water or beverages daily.

About a gallon is required daily for washing the face and hands, and if we add to this the quantity which is necessary for cleaning our clothes and houses, the amount runs up to 15 gallons. If to this we also add the amount required for that essential to perfect health—the daily bath—it brings the total up to 30 gallons a day for each person. Nor are these numbers high when compared with those of that ancient centre of civilization—Rome. The large quantity of 300 gallons per head, per day, was the amount of fresh water supplied, by a system of aqueducts, for drinking, bathing, and other purposes, to ancient Rome.

Sources.—Watcr may be derived from *rain*, *snow*, *ice*, *streams*, *springs*, *lakes*, *ponds*, *wells*, or from *collected surface rain water.*

Absolutely pure water does not occur naturally on the earth. At the moment that the aqueous vapour of the clouds condenses to form rain, probably minute drops of pure water are producced, but this watcr, on its journey to the earth, absorbs air and takes up solid particles. Thc moment the rain reaches the earth, so gcneral are its solvent powcrs, that it dissolves out particles of the rocks with which it comes in contact. The naturally great solvent properties of water are increased by the carbonic acid gas and oxygcn, which it has absorbed in its passage through the air. Water, then, as we know it, derived from any of the sources mentioned above, always contains matter dissolved in it, and

very frequently matter also which is mechanically suspended in it.

The substances which are **mechanically suspended** in water may fall to the bottom, when it is allowed to remain at rest for a time. Thus mud, sand, clay, chalk, starch, etc., may be mixed with water; but if it is kept quite still, after a time, they fall to the bottom of the containing vessel. Materials which are suspended in water in this way, may be removed by **filtration.**

The materials which are **dissolved** in water are held by it, and cannot be got rid of by allowing it to remain at rest. Nor can they generally be removed by filtration, but are only separated by **distillation.** That is, in order to recover the salt which you may dissolve in a given quantity of water, you must heat the solution and drive all the water off as steam; the salt then remains behind as a solid cake. The steam may be condensed by cold, and thus pure water may be obtained. Sugar and salt are familiar examples of substances which are **soluble** in water.

From the above we have learnt that water, on the earth's surface, may contain gases and solids dissolved, also solids mechanically suspended in it.

The most **common mineral or saline substances dissolved in water** are—*calcium carbonate*, *calcium sulphate*, *magnesium carbonate*, *magnesium sulphate*, and *common salt.*

Pure, or distilled water, is not used for domestic purposes, but is employed in the preparation of medicines, and is used in the arts. The solid, saline, or mineral matters, dissolved in water, make it more palatable and useful for us in some cases, for reasons which are explained later on. The salts present in water cause it to curdle soap, and impart to it a hard, harsh, or brittle touch, quite unlike the limpid, soft touch of distilled or rain water.

Hard water.—According to the presence or absence of certain mineral substances, waters are described as hard or soft. The chief hardening ingredients of ordinary water are **salts of lime** and **magnesia.** The two most important salts which, when present,

impart the property of hardness, are **carbonate of lime** and **sulphate of lime.** Some hard waters may be **partially softened by boiling**; examples of such we have in the London waters, those of the south of England generally, and those of most limy and chalky districts.

London water, and that obtained from limestone districts, as a rule, owes its hardness mainly to the presence of **carbonate of lime.** Quick, or pure lime, is slightly soluble in water. You learnt from the experiment described on page 12, that carbonic acid gas, passed through lime-water, converts the lime into **insoluble carbonate**; now, if more carbonic acid gas is passed through this water, the insoluble carbonate which made the water milky in our experiment disappears, that is, it is re-dissolved; in the words of the chemist—the carbonate of lime, in the presence of an excess of carbonic acid, takes more carbonic acid, and is converted into the soluble **bi-carbonate.**

Now **chalk**, or carbonate of lime, is very abundant in the rocks round about London, but you doubtless remember that it is **insoluble.** If a little is mixed with water, the liquid becomes white, but the chalk is simply mechanically suspended, for if the mixture be allowed to remain at rest, the carbonate of lime, after a time, falls to the bottom as a white powder. Then how is it, that the clearest and best filtered London water may contain, in an invisible form, this matter which we have said gives it hardness?

As **rain** falls it **absorbs carbonic acid gas from the air.** This passes through the rocks, and the water charged with carbonic acid has the power of converting some **insoluble carbonate** into a **soluble bicarbonate**; thus it is that rain water dissolves the hard rocky matter, and this explains why our water contains this invisible limy matter.

To the thoughtful reader it will, no doubt, at once occur that if it is possible by any means to get rid of this *excess* of carbonic acid, which holds the lime in an invisible form, the remaining limy matter will fall, because it is no longer soluble. **By boiling**

the water we can get rid of some of the carbonic acid; much of the insoluble carbonate is then deposited as a thin layer on the inside of the vessel. In this way the water is **softened.** Waters which may be softened by these means are spoken of as **temporarily hard.**

The above will, doubtless, suggest to many the full explanation of the formation of the layer of fur or crust on the insides of boilers and kettles. It is important to remember though, that the **fur does not consist of carbonate of lime alone,** but may contain salts of magnesia or iron, small quantities of silica, etc. These matters are not all deposited as the result merely of boiling the water, but the latter have been left behind by that water which has been driven off as steam. Were all the water sent away as steam, then **all the salts** would remain.

When a gallon of water contains one grain of carbonate of lime, it is said to possess one degree of hardness. When water contains more than seven grains to a gallon it is called "hard," when under seven grains it is considered "soft." All water, except rain water, contains from ten to fifteen or twenty degrees of hardness.

For domestic purposes **water is often softened** by adding to it soap, soda, potash, or lime. The alkali of the soap, or the free alkalies in the other cases, combine with the excess of carbonic acid and produce the required result.

The waters of many of the rivers of Scotland, and of some parts of England, cannot be softened by boiling. The hardness of such is due to the presence of **sulphate of lime** which is not rendered insoluble in the same way as the carbonate. They are therefore spoken of as **permanently hard waters.**

Very hard waters are objectionable, but it has not been proved that they are unwholesome because of their hardness. In fact, in some cases, the presence of mineral matter is of actual benefit. Thus, **rain, or soft water, will dissolve lead,** therefore, lead pipes should not be used for its conveyance, nor lead-lined cisterns for its retention. Hard waters, on the other hand, deposit an insoluble

coating of salts over the inner surface of the lead pipe or cistern, which mechanically prevents the water from acting upon the lead; therefore, in such cases, the chances of disease or death from lead poisoning are considerably reduced.

On the other hand, an excess of saline matters present in drinking water may cause, in some cases, stone in the kidney, or bladder. Goître, or "Derbyshire neck," is said to be caused by an excess of limy matter in the water.

Soft water is more useful in both the kitchen and laundry than hard. For example—ten ounces of tea brewed with soft water will produce as much, of the same strength, as eighteen ounces prepared with hard water; the same quantity of tea made with soft water is stronger, and requires less sugar, than if made with hard water. It has been estimated that about **one-third** of the tea consumed in London **is wasted** in this way. All our best cooks agree that it is impossible to make such good soup with hard as with soft water; vegetables, too, require much longer cooking, and are then not so well done in hard as in soft water; when cooked in hard water, they acquire a yellow colour, which, certainly, does not make them more tempting to the eye.

When water containing much carbonate of lime is used for cooking purposes, we labour under a great disadvantage; for this reason:—at the moment it boils, and when the joint, or vegetables, are beginning to be thoroughly penetrated, suddenly the separation of carbonate of lime alluded to above takes place; this is deposited in the pores, and upon the surface of the substance, which is thus hardened, instead of being rendered soft and succulent.

Where hard water only is accessible for cooking purposes, it may be softened by previous boiling. That water which has been boiled and re-boiled, and, consequently, out of which the dissolved air has been driven, is not good for cooking, or for making tea. Another plan for softening water is that adopted by many cooks, of putting a pinch of **carbonate of soda** into the water in which the vegetables are being cooked.

CHAPTER XVI.

IMPURITIES OF WATER.

Organic Matters found in Water.—Pollutions.—Filtering.—Absorbing Power of Water for Gases.

THE **organic matters** found in water are either **suspended or dissolved**, and are of animal or vegetable origin. They are of very serious importance, for they may, and often do, bring about such changes in the blood and system generally, when taken into the body, as result in disease. When present in water, even in the minutest quantities, they render it **unfit to drink**. These impurities include both carbonaceous and nitrogenous substances, derived from decaying organic matter. Such **pollutions** may arise from animal or vegetable matter of manure, etc., picked up by surface water, or that of shallow wells; or may be due to actual sewage matter, which has found its way into the water.

Many rocks contain **common salt**. It will, therefore, not appear strange when we remark that nearly all kinds of water contain some salt. But common salt is excreted with other waste products from the body, and is therefore present in sewage. Water, therefore, which contains much sodium-chloride should be looked upon with suspicion, for unless its presence can be otherwise satisfactorily accounted for, we might infer that it is derived from sewage, which has found its way into the water.

Purification.—Water, containing organic impurities, may be improved by boiling or by thorough filtering.

The **disease germs** of such fearful **epidemic diseases** as *cholera* and *typhoid fever* are very frequently introduced into water with the air and other gases it absorbs; or they may find their way into drinking water by leakage from sewers, etc. Frequently many

deaths in London and other large cities have been due to epidemic diseases, which have been traced to the milk supplied to the district. What is more, the poisonous matter contained in the stuff sold as milk, has been traced to the impure water which has been used to adulterate it. This water has been drawn from a shallow well, near

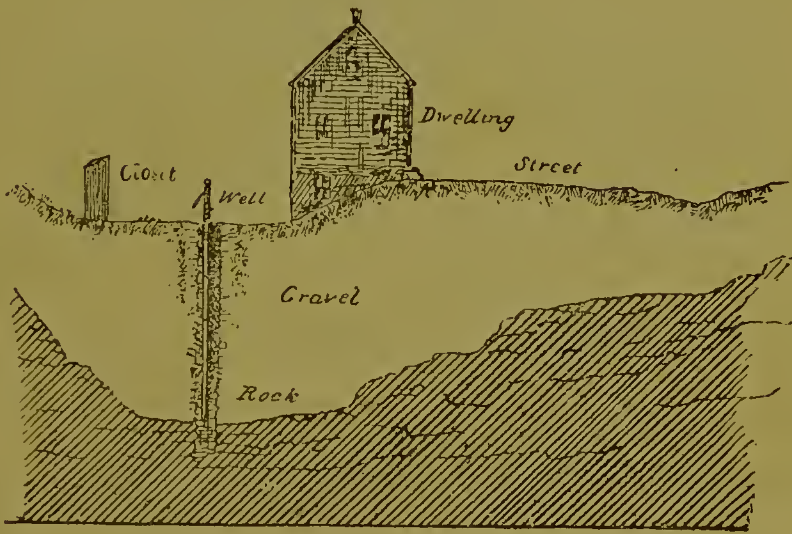


FIG. 2.

There were twelve cases of typhoid fever among persons using this well of water; the house became the centre of infection for a whole neighbourhood.

which a cesspool has been placed. On enquiry it has been discovered that the poisonous effete matter excreted by a patient suffering from the epidemic disease, had been cast into this cesspool. Some of the germs of the disease had, doubtless, been

carried by water into the well. Unfortunately, such cases are by no means isolated.

In country districts, the water of streams is very frequently rendered impure and unfit to drink in consequence of the actual sewage matters which are allowed to flow into it. *See Fig. 3.*

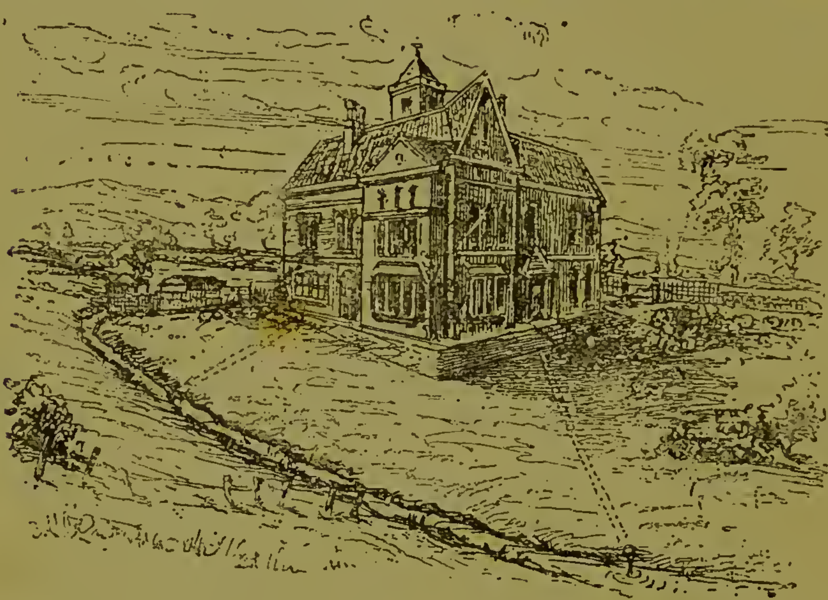


FIG. 3.

Excellent mountain stream, affording a supply to a country-house, and, at a lower point, to a small village. Defective drains and overflow from cesspools (shown by dotted lines) polluting the stream.

The impurities of water, as before explained, may be **organic** or **mineral.** The former may either be dissolved in the form of nitrates or compounds of ammonia, or suspended as minute particles of floating organic matter, some of which may even be living.

The most important organic impurities of water have their origin in sewage, which has percolated through the soil from drains or cesspools, or accidentally gained access to it. The organic sub-

stances which thus find their way into drinking water, nearly always contain nitrogen, and tend under the influence of heat to undergo rapid decomposition. These putrefactive changes are probably due to the growth and action of minute forms of life. Water in which such changes are taking place is exceedingly dangerous to drink.

The organic impurities of water may give rise to *diarrhœa*, *dysentery*, *cholera*, *ague*, *typhoid fever*, *diptheria*, and even it is recorded in some cases to epidemics of *scarlet fever*.

The waters of rivers and running streams, because they frequently receive sewage, are especially liable to give rise to disease. It is asserted by some that waters which have become polluted with sewage may be purified and rendered safe for drinking by passing them through filtering beds. Such sources of water-supply must always be looked upon with suspicion. Doubtless organic matters of sewage origin do decrease—some by subsidence, others are converted into harmless compounds by oxidation, whilst still others are made use of by water animals and plants.

The results of experiments and observation lead to the conclusion that the organic matter may exist in water :—

1. As unchanged dead or living matter—dangerous.

2. As ammonia, which represents an intermediate condition of the imperfectly oxidized and partially decomposed organic material —still dangerous.

3. As nitrites and nitrates, completely oxidized, and in themselves harmless substances.

Nevertheless, the concensus of opinion is doubtless against drawing a supply of drinking water from a river at any point in its course below that at which it has received sewage.

The **Mineral Substances** do not generally render the water unfit for drinking purposes. They, like the organic matters, may either

be dissolved in the water like sulphate of lime, sulphate of magnesia, etc., or may be suspended in the form of particles of sand and clay.

The **impurities found in water** have been classified according to their origin, thus :—

1. **Those received at the Source.**—The nature of these will be determined, by the strata from which the water springs or through which it passes. The proximity of the sea, cultivated land, grave yards, etc., to the source, all influence the character of the water.

2. **Impurities received in transit.**—These include such materials as sewage, refuse from factories, etc., which may find their way into the water during its passage from the source to reservoir.

3. **Impurities gained during distribution.**—For example, substances dissolved from metal pipes and gases absorbed.

4. **Impurities gained through mode of storage.**—Organic matter often finds access to water stored in wells, metallic salts may be dissolved and gases absorbed during retention in cisterns.

The **absorbing power of water** enables it to take up air and other gases. A very simple experiment will make clear the remarkable power water has of absorbing gases. If a glass gas tube or jar is filled with ammonia gas, or hydrochloric acid gas, and inverted with its mouth downwards in cold water, in a few seconds the water will absorb the gas and rise until it fills the jar. The beauty of the experiment may be increased by adding a few drops of litmus to the cold water, if ammonia is used, then, as it absorbs the alkali gas, it turns blue. In the latter case, if a little blue litmus is added to the water, the absorbed hydrochloric acid gas turns it red.

Common water contains dissolved in it 1·87 parts of nitrogen to

every one part of oxygen. The air contained in water gives it palatibility or taste; we ought therefore to use our water in as fresh a condition as possible, and not allow it to remain in tanks, jugs, or other vessels for a time before it is used. For if long exposed, the air may be displaced by other and injurious gases.

Many of my readers, no doubt, have noticed that when a jug of fresh-drawn cold water is allowed to stand for a time in a warm room, small bubbles collect around the surface of the glass. These are small vesicles of gas which have expanded and become visible in consequence of heat. On the application of further heat, as in boiling, they are expelled. It is from this dissolved air of water that fish obtain the oxygen which is as necessary to them as to the warm-blooded animals. The only difference being that in the cold-blooded animals, as fishes, etc., the rate of oxydation is less, and there fore the amount of oxygen required is not so great. Fish will not live in water which has been boiled and then allowed to get cold; because by boiling, the air, and so the oxygen, is driven off from the water. It is therefore necessary to force air into the water in tanks where many fish are kept.

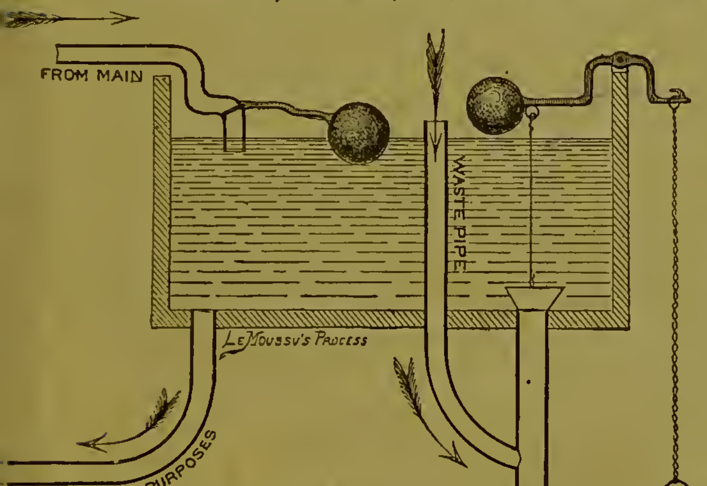


FIG. 6.

Section of a cistern from a house in London, Feb., 1884. Showing how water may be contaminated in the cistern by gases from drains and sewers. In this case, not only did the pipe to the closet open directly into the tank from which drinking water was used, but, at the same time, a waste pipe served as an open channel through which the sewer gas passed to the water in the cistern.

If then water will absorb gases, it is of the very greatest importance that the tank or any vessels in which it is stored for use should not be placed in such a position that stagnant or foul air and poisonous gases may come in contact with it. The cistern should not be placed near a dust bin. A separate and special tank should be supplied to the closet, and in no cases should water for drinking or cooking purposes be used from such. The waste pipe from the tank should not communicate directly with any drain pipe, or in any way be so exposed that impure air may find access to the tank by its means. The cistern should be placed in such a position in our houses that pure air can flow freely over it.

CHAPTER XVII.

STORED WATER.

The Cistern.—How to Clean a Cistern.—Impure Water.—Tests for Salt, Lead, and Organic Matter.—Good Drinking Water.

THE **cistern** is very frequently a great vessel, placed in some dusty, inaccessible corner of the building, in which the water brought to our houses is stored and rendered impure. It is not uncommon to find the cistern in some dark corner, covered with cobwebs, and containing the dead bodies of insects, and sometimes those of mice and rats. Too often the cistern is placed in such a position, beneath the floor, or roof, that it receives a large quantity of dust and dirt.

If we use a cistern for the storing of water, then it should always be so placed that it may be easily cleaned from time to time. In cleaning it, the dirt and sediment which has collected at the bottom, should first be removed by stirring up the water. The sides and bottom should be carefully washed with a soft brush to remove the dirt. Water should then be allowed to run into the tank ; this should be agitated, and then allowed to escape. This operation must be repeated until the water which leaves the tank is as clean as that which runs in.

Great care must be taken in cleansing the tank not to remove the coat or crust of mineral matter which is attached to the sides and bottom. It is not necessary to make the metal sides of the tank bright; for if the bright metal is exposed, by removing the protective crust, the water will act upon it, and produce poisonous metallic salts.

The water drawn from the upper part of a tank may be quite clear and bright, whilst at the bottom there may exist a thick layer of sediment, which only becomes mixed with the water when a large quantity is withdrawn from the tank. Thus, when a cistern is in such a condition, if a little water is withdrawn after a large quantity has been used for the morning bath, it will be found to present a cloudy appearance, and yields a yellowish deposit. Therefore, **clean the tank frequently**, and do not trust to the usual appearance of the water. Cisterns should be cleaned once a month at least, if made of slate or cement; and remember, very great care is required if they are made of lead.

Never use stagnant water, and that which has long remained in the cistern or pipes. A good plan, in reference to **tap water**, is to allow the water to run to waste for a time before collecting any for use; thus, water which may have been stagnant in the pipes will be discharged.

Water is frequently **contaminated** by the vessels in which it is collected and stored. These remarks apply more to the poorer classes. In the homes of such, it is not an uncommon sight to see the same pail that is used for carrying slops and washing water, after receiving a preliminary rinse with clear water, filled with that which is to be used for drinking purposes. The vessels used for carrying and storing drinking water should be **scrupulously clean.** The best kind of vessels are those made of tin, or iron covered with tin. Drinking water should not be used from galvanized iron vessels.

Impure water, that is water which contains organic impurities, disease germs, injurious gases, or such poisons as salts of lead,

should be guarded against. When such is taken, if it does not directly cause disease, at least it predisposes our bodies to the attacks of diseases, such as cholera, typhoid fever, and diarrhœa; and, where even no actual disease breaks out, the use of impure water so lowers the vital powers, that man is less fitted for mental and muscular work; health is broken down, and life shortened. *But how are we to know impure water?*

Simple tests for mineral matters present in water. *Salt.*—The method to be adopted for testing for common salt in water is very simple: procure at the chemists a little nitrate of silver (lunar caustic), and prepare a solution of the substance in **distilled water**; now add a few drops of the clear, colourless solution of nitrate of silver to a wine-glass full of the suspected water; a slight bluish-white cloudiness indicates the presence of salt; if the liquid becomes white and thick, or curdy, too much salt is present for the specimen to be wholesome. Remember that this may have been derived from sewage, *see page 58.*

Test for lead.—To the suspected water, add a few drops of hydrochloric acid (muriatic acid) then add to the liquid a solution of sulphuretted hydrogen, or, better still, let the pure sulphuretted hydrogen gas pass through it; if a brown tint is produced, lead is present. Lead should always be looked for in rain, or soft water; it may be taken up by water, from leaden roofs, cisterns, or pipes.

Tests for organic matter.—Evaporate a quart of any ordinary water in a glass, or porcelain dish; when all the water has gone off as steam, a residue is left; if this residue is white, and looks somewhat like common salt, then we may infer that it is mainly mineral matter; on the other hand, if the residue is dark in colour, yellowish, or greenish, the water must be regarded with suspicion. The dark-coloured residue may be further heated; it probably darkens, begins to burn, and emits an offensive odour like that of burning rags: such indicates the presence of much organic matter.

Another and simple test for organic matter is that known as the **permanganate of potash**, or Condy's fluid test. These two

substances contain an excess of oxygen, with some of which they will readily part. The organic matter of water is oxydizable matter, that which will readily combine with oxygen.

The two test fluids above mentioned are dark ruby-coloured liquids, the composition of which is altered when they lose oxygen; the change in composition is also attended by a change in colour; organic matter will produce this change. Add enough of Condy's fluid to the water under examination to make it of a rich ruby tint, and allow it to stand for a few minutes; if the colour partially or wholly disappears, we may infer that little or much organic matter is present; if it retains its colour, without throwing any sediment for ten or twelve hours, it is not contaminated.

The permanganate of potash solution may be prepared by adding some crystals of the salt—to be procured at any chemists—to distilled water. The above tests cannot always be relied upon, for other matters—such as salts of iron—not necessarily injurious, may produce the same effects as organic matter.

Good drinking water should have a pleasant, sparkling, but **no decided taste.** It should be bright and clear, when a glass filled with it is held up to the light. If stringy matter or specks are present, which give the water a hazy or cloudy appearance, it should be regarded as in an unwholesome condition. Good drinking water is **free from smell** of any kind, except, perhaps, when perfectly fresh, it may give rise to the same sensation—we can hardly call it odour—as fresh, pure air. Some waters, after they have been stored in vessels for a time, give out a most decided and generally objectionable odour. These should always be regarded with suspicion.

In judging, therefore, of the value of water, we should take into consideration the questions of **taste, clearness, colour,** and **smell.**

CHAPTER XVIII.

PURIFICATION OF WATER.

How to get rid of the Impurities of Water.—Filtration.—Materials used for Filters.—How to Clean a Filter.—A Poor Man's Filter.—Granular Carbon.—Filtre Rapide.

HOW **may we get rid of organic impurities?** In some cases by the **addition of a little alum,** in others by **boiling,** but generally by **filtration.**

When peaty matter is present in water it imparts to it a yellowish tinge, which may be mainly removed by adding about three thimblefuls of alum to a bucketful of the water. The astringent properties of the alum cause the precipitation of the organic matter, and it does not render the water unwholesome.

Boiled water is considerably improved as a beverage, if, whilst it is hot, it is poured over a piece of toasted bread, which should be crisp and toasted externally—almost to charring. The **toast-and-water** thus produced is of a bright amber colour, perfectly clear, pleasant, and wholesome.

A **filter** should be regarded as one of the absolute necessities of every well-ordered home, for by means of a good filter the organic impurities may be removed from the water. The best materials for filtering are **clean small gravel, sharp clean sand, charcoal and spongy iron.** Those filters are especially to be recommended which may be easily taken to pieces and cleaned. One great objection to several of the otherwise good filters now in the market is that they must be sent to the makers, at considerable cost, to be cleaned. Many of those who go so far as to purchase a filter, think that at this point their trouble in the matter ceases, and that the filter will do its work well for an indefinite period. All filters require cleaning from time to time, some of course more frequently than others. A new or clean filter will stop the impurities of the water; but after a time the filtering medium becomes charged

with these impurities, and is then worse than useless, for it adds to the impurity of the water which passes through it.

We shall better understand how filters may be cleaned if we first learn upon what their purifying powers depend. The actions going on in the good filter are mechanical and chemical. Sand

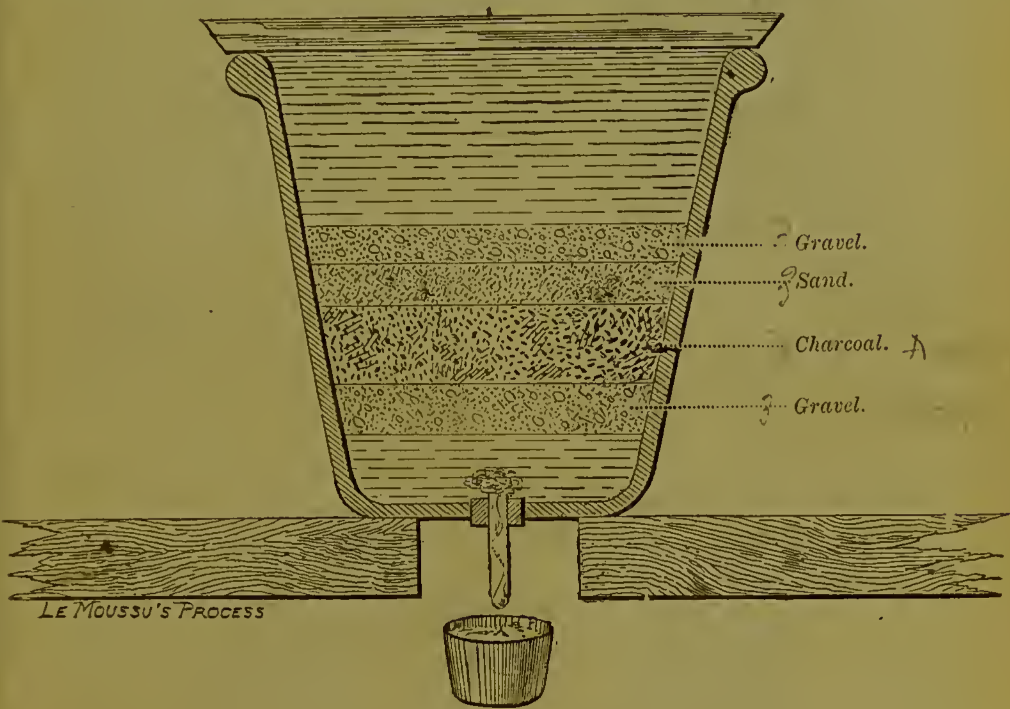


FIG. 7.—A POOR MAN'S FILTER.

A large flower-pot which has been thoroughly cleansed and soaked in water. The hole at the bottom of the pot is fitted with a piece of sponge and piece of glass tube; layers of gravel, sand, and charcoal act as the filtering media.

and gravel act chiefly mechanically; but the air contained between the particles of sand aid in the oxydation and change of the organic matter. Spongy iron and carbon are both exceedingly porous, and

in their pores there exists, in a condensed form, air with oxygen. Particles suspended in the water may be mechanically separated on the surface of the spongy iron and carbon; but when the water passes through the pores of these substances, the oxygen does its oxydizing and purifying work. It necessarily follows, then, that the surface and pores of the carbon become clogged with the impurities thus separated from the water.

To clean a filter, then, we must be able to remove the carbon and clean it. In cleaning, the carbon should be well brushed or scraped, then well soaked and washed in a solution of one ounce of hydrochloric acid mixed in one quart of water, to which a small bottle of Condy's fluid has been added. If no Condy's fluid is at hand, a few crystals of permanganate of potash should be added to the weak solution of acid, sufficient to give it a dark purple colour. After well soaking and washing the carbon in this solution, it should be well washed in clean water, and afterwards dried by heating it before the fire, or by placing it in an oven. In cases where it is difficult to remove the filtering carbon the following solution should be prepared and run through it :—

Three pints of water, to which a few crystals of permanganate of potash are added, sufficient to impart a rich purple tint, and one ounce of hydrochloric acid. Plenty of water should then be allowed to run through the filter until it has no acid-taste nor colour.

The **Patent Granular Carbon Filter** is manufactured by Messrs. Doulton & Co. of Lambeth. In these filters a block of manganous carbon at A, Fig. 8, which is screwed on to the upper plate of the filter, begins the purifying work before the water passes into the granular carbon.

Messrs. Doulton's **Manganous Carbon Refrigerator Filter**, which contains a compartment in which ice or some freezing mixture may be placed, insuring a draught of pure cold water at all times.

Maignen's Patent "Filter Rapide," of which illustrations are given next page, is one of the simplest and best filters in the market.

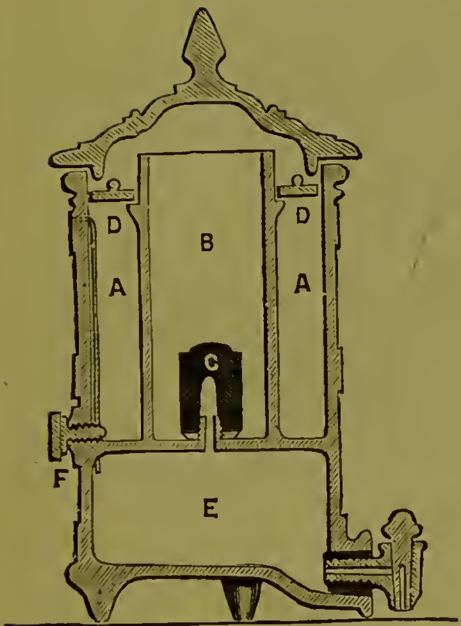


FIG. 8.
MANGANOUS CARBON REFRIGERATOR FILTER.

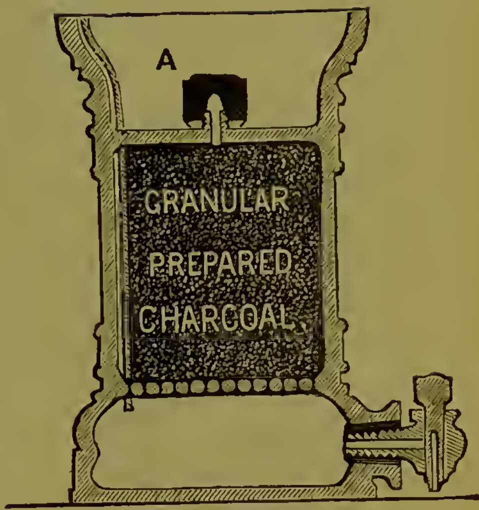


FIG. 9.
GRANULAR CHARCOAL FILTER.

It is inexpensive, most effectual in its work, rendering turbid and impure water bright and wholesome, and may be easily cleaned by the user. Figs. 10 and 11 represent two forms of this filter, known respectively as the "Bijou" and "Cottage."

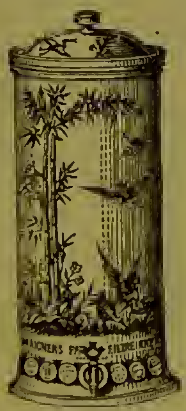


FIG. 10.—"BIJOU" FILTRE RAPIDE.

FIG. 11.—"COTTAGE" FILTRE RAPIDE.

In Fig. 12, we have a section of this first-class filter. R is the reservoir for the filtered water. It is accessible for cleansing, as the filter case proper simply rests loosely in it. M is the filtering

FIG. 12.

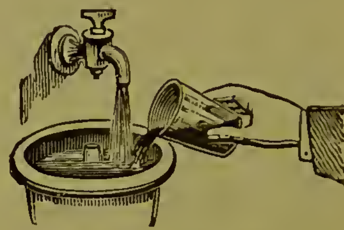


FIG. 13.—SETTING.

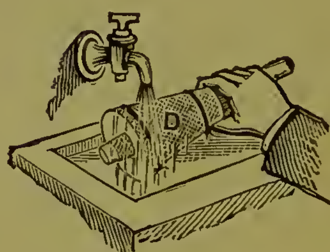


FIG. 14.—CLEANSING.

frame covered with asbestos cloth (E), which is tied with asbestos cords. D is a layer of powdered filtering medium, known as Maignen's Patent Carbo-Calcis—deposited automatically by being mixed with the first water poured into the filter, as shown in Fig. 13. C is granular carbo-calcis put in loosely to fill all the available space between the layer of powdered carbo-calcis and the screen B.

The water having been put into the filter, goes first through the granular carbo-calcis, then through the layer of powdered carbo-calcis, and the asbestos cloth issuing into the hollow filtering frame

M. in a most minute state of division. The course of the filtered water is shown by double arrows; it meets with pure air (shown by single arrow), which has filtered through a plug of cotton wool, and it falls (shown by treble arrows), perfectly pure and aërated, into the reservoir R. By this means the water is most thoroughly purified and oxygenated, and thus rendered sparkling and bright.

The filter requires cleansing from time to time; the period at which it should be cleaned is, of course, determined by the amount and nature of the water passed through it. One of the good points of this filter is that this may be easily done at a very slight expense by the owner himself. The filter case is upset, and the granular carbo-calcis falls out—the filter frame is then taken out, and the layer of powdered carbo-calcis washed off as shown in Fig. 14. The parts may then be replaced and the filter re-charged with fresh carbo-calcis.

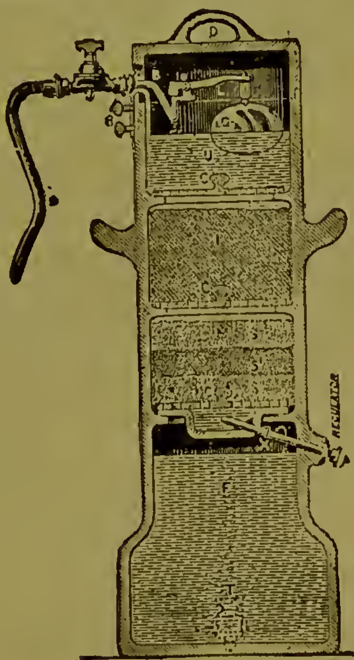


FIG. 15.—SECTION OF SPONGY IRON FILTER.

The Spongy Iron Filter.—In Fig. 15, we have a sectional

drawing of one of these filters, in which B is the ball-cock, U unfiltered water, V screw valve, I spongy iron, *s s′ s″* prepared sand, F filtered water, T stop-cock, A regulator. Smaller forms of this filter we believe are also made.

In purchasing a filter the following points should be borne in mind :—

1. *A perfect filter must not contain any material which can impart injurious or offensive qualities to the water which passes through it.*

2. *It must remove, not only the mechanically-suspended matter, but also the organic impurities held in solution.*

3. *It must be constructed so that the user himself can take it to pieces, and thoroughly clean it with little trouble and at very little cost.*

What water requires filtering ?—It is quite the best plan to filter all water which is used for drinking purposes; but, of course, some waters need filtering more than others.

All river water and that from **shallow wells** is dangerous, and **should be well filtered,** if not boiled. Surface water, or stored rain water, and our London water, is suspicious, and should be filtered.

Spring water, and deep well water, is generally wholesome, and there is much less need of filtering this than any other.

The delivery of water.—In London, and most other large towns, the water is laid on in pipes, by means of which it is either delivered to each house, or one pipe supplies several houses.

The supply is either **intermittent** or **constant.**—In the case of intermittent supply, the water is turned on for a certain time daily so as to fill the cistern ; when the supply is constant the water is always on, so that it may be obtained at any time. In the former case, we are exposed to the danger of the water becoming impure in the cistern by storage, and we may also run short of water ; in the latter, there are no such difficulties to deal with. There can be no doubt that, of the two, the constant is by far the best. It is to

be hoped, that for the benefit of the community at large, the day is near when the plan of constant supply will become general.

CHAPTER XIX.

TEA.—COFFEE.—COCOA.

The Tea Plant: Preparing Tea.—Action of Tea on the System.—Coffee: Active Principles of Coffee.—Cocoa and its Action as a Food and Stimulant.—Rules about Drinking.

AFTER having learnt something of water and its uses, we may consider the nature of the composition and action of some other of our liquid foods.

Tea is obtained from a plant which belongs to the same family as the well-known camellia, but it is smaller; the leaves are not so thick, and are less glossy. The leaves are gathered in the fourth year of the plant's growth; and the operation is repeated yearly until the tenth or twelfth year, when the plants are usually dug up, and the space re-planted.

In the preparation of green tea, the leaves are rapidly dried, whilst in preparing black, they are allowed to ferment for a time, and then slowly dried.

The bloom and colour of many bright-looking green teas are produced by Prussian blue, indigo, and china clay.

In **making tea** the water should be boiling the moment it is brought in contact with the leaves. The tea-pot should therefore be made hot by previously pouring into it boiling water, which is afterwards emptied out. To have the full flavour of the tea, it is necessary to drink the infusion soon after it is made. The **aroma** is best brought out by placing the pot containing the tea before the fire, and then pouring on boiling water. If hard water only is accessible, it should be either thoroughly boiled, or it should be employed at the moment that it boils; for after it has been boiling only a few minutes, the salts of lime begin to separate, and good tea cannot be prepared. A little bicarbonate of soda added to

hard water to be used for making tea improves it. If we wish to have the tea in its best condition, the tea-pot should be kept hot.

Tea contains a **volatile oil** which acts as a powerful stimulant, it should therefore be infused, not boiled, for the volatile oil is liberated by heat. But by infusing the tea too long, the bitter astringent principles are extracted, and the beverage becomes disagreeable, and unfavourable to health in consequence of its action on the digestive and other organs.

The action of tea may be described as stimulating and exhilarating, yet it appears to soothe the vascular system, as in headache. In delicate and nervous persons, strong tea will produce restlessness, palpitation of the heart, and extreme wakefulness. The brain is excited by it to increased activity, and hence it is in general favour with hard-working students.

The action of green tea is more marked than that of black; in some cases it acts as a narcotic, or it produces nervous trembling and extreme excitement. In many of the lower animals, green tea so acts on the nervous system as to produce paralysis.

The **aroma** of tea depends upon the presence of a **volatile narcotic oil**; the stimulating action is due to the crystalline principle **theine**; and the **astringent property** to **tannic acid.** It is said that whilst theine excites the brain, it prevents rapid change and waste, and therefore economises the food. The **tannic acid** often amounts to 18 or 20 per cent. Tea usually contains about 18 per cent. of flesh-forming matter; but this usually remains with the leaves. Tea should not be taken when much food is eaten, for it tends to check digestion by its astringent action.

Coffee is the berry of a plant which belongs to the same family as those which supply us with *cinchonin*, *quinin*, *ipecacuanha*, and *Peruvian bark.* The active properties of coffee depend upon the presence of a **volatile oil, caffein,**—an alkaloid like quinine, and **caffeic acid,** a substance allied to tannin, which is combined with caffein. Some samples contain as much as thirteen per cent. of fat.

The presence of so large a quantity of fat makes it less digestible than tea. On the other hand, it yields a larger quantity of nitrogenous matter, and is therefore more nutritious.

Coffee acts chiefly on the nervous system; it is exhilarating, arouses and keeps one awake, and may be used to counteract the stupor caused by fatigue, disease, alcoholic drinks, or opium. To a certain extent it soothes the body and decreases the rate of change and waste; hence the demand for food is less, and hunger is allayed by it. Taken in moderation it is highly refreshing and reviving, and allays the thirst. When indulged in to a great extent it may produce dryness of the skin, thirst, and symptoms of fever with accelerated circulation, or muscular tremor. In time this may be followed by congestion, dyspepsia, loss of digestive powers, and obstruction of the liver. These results are only produced when coffee is taken in excess. Those who suffer from constipation should not indulge in its use. It appears to be of value in cases of gout and gravel, and it is a remarkable fact that in countries where it is largely used, these diseases are almost unknown. There of course may be, and doubtless are, other causes aiding also in producing this result.

The coffee sold in England is generally adulterated. That provided as drink at public places is generally of a very poor character. The people of this country have yet to learn how to prepare coffee, so that the aroma and flavour is brought out. The prepared coffee sold at the grocers is frequently adulterated with chicory. The value of coffee as a food is considerably increased when it is prepared with milk.

Newly roasted coffee, freshly ground, makes a most refreshing beverage, and one that is in high favour amongst brain workers.

Cocoa is prepared from the seeds or nibs of a plant called by Linnæus, *Theobroma Cocao.* This name seems to embody the great botanist's idea of its value, for Theobroma signifies—food for gods. Cocoa, like tea and coffee, contains a **volatile aromatic oil,** and an alkaloid **Theobromine,** which, though not identical with, is

allied to theine and caffein. Cocoa contains a large quantity of fatty matter, known as cocoa butter. **Cocoa-nibs** often contain as much as 55 °/₀ of this fatty substance; they contain 22 °/₀ of starch, sugar, gum, and cellulose; and from 16 to 17 °/₀ of gluten; with about 1·5 °/₀ of the nitrogenous alkaloid, theobromine.

Good cocoa is a nutritious, wholesome, and, in all, an excellent drink and food combined. It may be recommended where a nourishing and heat-giving diet is required, and is a very healthful and useful food for breakfast or supper. Owing to the large quantity of fat present, ordinary cocoa does not agree with, and cannot be well digested by, some persons; such are recommended to try the homœopathic cocoa, which contains very little fat. I believe that cocoa and chocolate supersede, in regard to their general usefulness, both tea and coffee, and would recommend cocoa for breakfast, or the evening meal or supper; it is certainly to be preferred far before stimulating tea and coffee.

The great advantage of all the foregoing drinks is that they must be prepared with boiling water, and thus the water is, to a certain extent, purified before the preparation of the beverage. By boiling, you will remember, many organic impurities may be destroyed. For children, milk, or hot milk and water, is to be preferred for breakfast and tea, before either tea and coffee.

Drink, in some form, is absolutely necessary for life. Many circumstances co-operate to regulate and determine the form and amount which should be taken, but much inconvenience, ill health, and many diseases are the result of errors in drinking. We shall therefore give next a few **rules about drinking.**

1. *Do not drink immediately before a meal.* If much liquid, even water, is taken just before a meal, the gastric juice is thereby largely diluted and its activity decreased. Hence violent exercise should be avoided before dinner, for active exercise is attended by copious perspiration, and this is followed by thirst.

2. *Don't drink much during a meal,* for if a large quantity of liquid is taken, it so distends the stomach and dilutes the digestive

fluids, that the digestive changes are impeded. A small quantity of drink taken with the food aids digestion. Of course, the drier the food and the larger the quantity we take, the more water we require and may take in moderation.

3. *Only drink when thirsty* if you value your health and wish to avoid throwing unnecessary work upon the organs of the body.

4. *Don't take very hot drinks* if you prize your health. Hot drinks act upon the teeth, destroying the enamel and facilitating their decay. They also so act upon the coat of the stomach, that they check its action and give rise to dyspepsia and its attendant evils.

CHAPTER XX.

FERMENTED DRINKS.

Fermented Drinks.—Use and Abuse of Stimulants.—Alcohol.—Its influence upon the Body.—Vascular Excitement. Do Alcoholic Drinks Warm us ?—Loss of Power.—Insensibility.

FERMENTED **drinks** include all kinds of spirits, wines, and malt liquors used as drink by man. They all contain **water, sugar, acid, mineral** and **colouring matter**, with **alcohol.** The active agent in all alike which produces such marked effects upon the system when they are used as beverages is alcohol. We are therefore brought face to face with two of the great questions of the day—is alcohol food ? Should alcoholic drinks form a part of our daily diet ? Our knowledge of the action of this agent in limited quantities is not yet complete, and it appears impossible with our present limited information to give a decided answer to these questions. Yet the weight of evidence does certainly appear to be in favour of total abstinence.

We have most abundant daily evidence that **alcohol, taken in excess,** destroys health, produces disease of the lungs, liver, heart, kidneys, and nervous system, resulting in early death; when taken, even in moderate quantities, for a short time, it acts as a stimulant, producing increased circulation, and nervous activity; this result is succeeded by marked exhaustion, and a craving for more of the stimulant.

The statistics drawn up by Mr. Neison show that a temperate person at 20 may live 44·2 years, but if at 20 he becomes intemperate, he will live 15·6 years; he thus shortens his life by 28·6 years.

A temperate person's chance of living is—		An intemperate person's chance of living is—	
At 30 =	36·5 years.	At 30 =	13·8 years.
„ 40 =	28·8 „	„ 40 =	11·6 „
„ 50 =	21·25 „	„ 50 =	10·8 „
„ 60 =	14·285 „	„ 60 =	·89 „

The awful fact of shortened and wasted lives brought home to us by these, and similar statistics, must not be attributed to the direct action of alcohol on the organism alone; but the high death rate, and short lives of the intemperate, are, in part, due also to the privations and exposure which they undergo. Of course these very privations—bad and insufficient food, bad clothes, etc.—are indirectly the result of excessive indulgence in alcoholic drinks.

Of the extent of the evil and crime which attend the drunkard's career, we can only form a faint idea by careful observation. No statistics teach us of the homeless and starving wives and children, whose health is broken down, or life cut short, as the result of diseases indirectly produced by alcohol.

In common with many physiologists, the writer of these pages holds the opinion that man's natural drink is water; but, in our crowded town life, one of the best arguments advanced for the moderate use of alcoholic drinks is the impure state of our water supply. Every now and again we have brought home to us the lesson that there is poison in water; that milk may carry the poisonous germs of disease; and that poisons are present in *all* stimulating drinks. This recalls to one's mind Coleridge's lines in the "Ancient Mariner"—

> "*Water, water everywhere,*
> *Nor any drop to drink.*"

Again, although man's drink in a natural state may be water, do we, in this age of high pressure, live a natural life? In how many respects are we artificial? In this age of competition in trade, over-crowding, hurry, drive, and competitive examinations—with our over-worked nervous systems—it appears to me that there may be reasons, in some cases, why moderate quantities of stimulants should be taken. The impurity of the atmosphere in which we live, the character of the water supplied to us, bad food, unhealthy surroundings, and the habits of our town life—all so operate upon the system, reducing the vital powers, as in certain cases to render the moderate use of wine or beer of certain use.

There is little doubt, on the other hand, that the robust and healthy, and those generally who live under more favourable conditions, can do and are far better without wine, beer, or spirits.

Alcohol—the active principle present in all alcoholic drinks—consists of **carbon, hydrogen,** and **oxygen** (C_2H_6O). The effects produced when this agent is introduced into the body vary with—

1. The quantity taken.
2. The condition in which it is taken.
3. The general condition of the body at the time.

In speaking, therefore, of the effects of alcoholic drinks as a class, we must keep in mind the differences which are only due to variations in quantity.

The first effect of alcohol is to produce vascular excitement, which is followed by exhaustion. When a small quantity is taken, some of it is at once absorbed by the small blood-vessels of the stomach, and thus passing into the blood stream is carried through the whole body.

The smaller, in common with the larger, blood-vessels are supplied with muscular coats. These layers of muscular fibres run round the little tubes, and are usually in a contracted state, and hence tightened on the blood which is flowing through these vessels. To the muscular coats small nerves are distributed, which have the power of controlling the contraction of these coats, and

so regulating the blood supply. These nerves are so affected by alcohol that their power of controlling the little muscular rings is reduced. The muscular coat of the blood-vessel relaxes, and, consequently, the flow of blood is increased.

When a little alcohol is introduced into the stomach, the lining membrane *blushes*, owing to the increased blood supply, which is the result of the action of the alcohol on the minute nerves of the blood-vessels. The increased flow of blood to the stomach wall is at once followed by an increased secretion of gastric juice. Thus, when a *small* quantity of alcoholic drink is taken mixed with water, the food is more rapidly and thoroughly digested. Unless it be well diluted, digestion is impeded, and the structure of the coat of the stomach becomes in time thickened and changed.

In other parts of the body this blush, the result of increased vascular supply, attends the use of alcohol. A small quantity, even, makes the neck, face, and hands redder, showing that the blood supply has been modified in these parts. This is not only true of the exposed parts of the body, but equally true of those parts covered by clothing and the internal structures. If we examine the pulse under these conditions, we find that it beats faster and becomes more full, and the strokes of the heart are stronger—it is doing more work.

This **vascular excitement** means that in all the organs of the body the blood is flowing more quickly and in larger quantities. Such increase is generally at first attended by increased activity of the organs, for their activity depends mainly upon the amount of blood which they receive. The reaction comes sooner or later, and this excitement is followed by exhaustion, which is marked by a desire for more of the stimulant.

Does alcohol warm us? This stimulating effect does not result in any real benefit; but it has, unfortunately, led many into the error of supposing that alcohol makes us warm. In other words, that this substance raises the temperature of the body. Such is very far from the truth, for as a fact, the temperature of the body

is really reduced by it. The blood-vessels distended by the current of hot blood may suggest to the cab driver that he is warmed by the spirits he has taken. What really takes place in such a case is this—the alcohol acting as above described upon the nerves of the blood-vessels, the blood supply is increased, this is attended by the sensation of a warm glow, which produces the erroneous impression that alcohol is a warming substance. Really, the increased flow of blood means that a larger quantity has been exposed at the surface of the body in a given time. Hence, a larger amount of heat has been lost from the surface in the same time. Thus, then, the alcohol has promoted and accelerated a rapid cooling of the blood and so of the body. Hence the driver soon wants his second or third glass to "keep out the cold." We have seen from the above that alcohol neither keeps out the cold, nor does it make us warm, but that it decreases the temperature of the body by accelerating the loss of heat.

Arctic explorers agree that **alcoholic drinks are** not only completely **useless to keep out the cold,** or for any other ordinary purposes in high latitudes, but that they are positively injurious. Alpine guides will not allow those under their charge to take alcoholic drinks, knowing from experience that travellers are less able to withstand the cold and bear the hard work of the ascent if they indulge in stimulants. The monks of St. Bernard, and the officers who commanded during Napoleon's march to Russia, alike have borne witness to the fact that alcohol only hastens death by cold, and that those indulging in its use are less able to bear exposure. As far as experiment and observation have carried us at present, we may say that alcohol in no case actually increases the amount of heat in the body, but rather tends to reduce it.

The vascular excitement or blushing produced by alcohol is common to the delicate organs like the lungs, brain, and kidneys, as well as the skin. The dilated vessels in these organs permit of sudden cooling. It is in this way that alcohol may induce congestion and other diseases of such important organs as the lungs, etc.

The foregoing facts refer only to the first effects produced by the use of alcohol in small quantities. Its action on the nervous system appears to be two-fold—it first excites and then deadens.

The second stage is marked by excitement and exhaustion of the spinal cord and its nerves. The spinal cord is the great nervous mass which, continuous with the brain, runs down the opening in the backbone. This cord and its fibres are concerned in producing and regulating the action of the voluntary muscles.

The moderate quantity of alcohol carried in the blood-stream, we learnt above, acted upon the fine nerve threads supplied to the blood-vessels. An increased quantity so acts upon the great cord of nervous substance and its many branches and fibres, that the controlling power over the voluntary muscles is very largely destroyed. The individual under this influence stretches out his hand to reach, but cannot take hold of an object. The muscular contractions are generally disorderly and feeble. In young subjects this stage is marked usually by those muscular contractions of the stomach that give rise to vomiting; in this way much of the injurious matter may be got rid of.

Gradually this action of the spirit on the nervous matter extends until the **third stage** is reached. This is **marked by unbalanced reasoning**, and power of orderly voluntary movement is lost. The language now is incoherent, the thoughts disconnected, the speech difficult, and the voice thick, husky, and broken. Dr. W. B. Richardson, the great scientific worker in this country on the subject of alcohol, and the apostle of total abstinence, thus described the third stage of alcoholism in his Cantor Lectures before the Society of Arts :—"The alcoholic spirit carried yet a further degree: the cerebral or brain centres become influenced; they are reduced in power, and the controlling influences of will and of judgment are lost. As these centres are unbalanced and thrown into chaos, the rational part of the nature of the man gives way before the emotional, passional, or organic part. The reason is now off duty, or is fooling with duty, and all the mere animal instincts and sentiments are

laid atrociously bare. The coward shows up more craven, the braggart more boastful, the cruel more merciless, the untruthful more false, the carnal more degraded: '*in vino veritas*' expresses, even indeed to physiological accuracy, the true condition. The reason, the emotions, the instincts, are all in a state of carnival, and in chaotic feebleness."

The third stage is succeeded by the **fourth**, in which the action of the alcohol has spread to the great nervous centre—the brain—and now it affects alike the whole nerve supply of the body. This stage is marked by **total collapse of the nervous and voluntary muscular powers.** The body now lies an insensible mass, and all power of voluntary movement is for a time lost. The term "dead drunk" has been applied to, and in a certain way *really describes*, this stage.

CHAPTER XXI.

ALCOHOL AND ITS EFFECTS.

Does Alcohol Fatten us?—Alcohol as an Aid to Digestion.—A Moderate Quantity.—Proportion of Alcohol in Different Drinks.—Its Effects on the Heart and Stomach, Lungs, Kidney, Liver, and Brain.

DOES **alcohol fatten?**—There is abundant evidence that alcohol decreases the waste and decay going on in the body; hence it economises the food and lessens the quantity required. Therefore, although it is not a fat-forming substance itself, yet by decreasing the rate of change it aids in increasing the weight of the body. For the same quantity of food being taken, less being used, more remains to add to the weight of the organism.

Inasmuch as less work is done and less waste got rid of under the influence of alcohol, the amount of uric acid and urea—waste substances which should be thrown off by the kidneys—accumulates in the system, where they give rise to disease. It necessarily

follows that, although it may be demonstrated that the weight of the body may be increased by taking alcoholic drinks with food, yet it is a dangerous mode to adopt to say the least.

Dr. Hammond performed a number of experiments upon himself, and proved that when alcohol is taken with insufficient, sufficient, or more than sufficient food to maintain the weight of the body in a healthy state, that, in each case, the addition of alcohol increased the weight. He found that when alcohol was taken with the amount of food which was sufficient, or more than sufficient, to maintain the body at its normal weight, disturbances were produced in the system, amongst others—*rapid pulse*, *palpitation*, *dyspepsia*, and *general indisposition* to *mental* or *physical work*.

Alcohol in small quantities does appear, in some cases, to **increase the appetite, and aid digestion.** In certain cases of defective appetite, the benefit of wine cannot be questioned; it appears, under such circumstances, to assist by stimulating the appetite and assimilation of food.

A moderate quantity of alcohol.—What are we to consider a small, or moderate quantity? From observation and experiment, we are led to believe that, in the case of the healthy adult, little harm is done when the amount of absolute alcohol taken does not exceed 1½ ounces in 24 hours. When the amount is increased to more than two fluid ounces, the strength is decreased, and nutrition impaired. General degeneration of the tissues, and disease of the liver, heart, lungs, or kidneys, may follow. Any amount, therefore, above two fluid ounces of absolute alcohol in 24 hours, we shall term excess.

It will be interesting now to learn about how much of the different alcoholic drinks, will yield this quantity of absolute alcohol.

Relative qualities of Absolute Alcohol contained in Fermented Drinks.

Drinks.	Per-centage of absolute alcohol.	Average per-centage of absolute alcohol.	Quantity representing about *one* ounce of absolute alcohol.
Malt Liquors—			
Ale	1·2 to 10	5	20 ounces or 2 tumblers.
Beer			
Porter			
Stout			
Light Wines—			
Rhine Wines ...	6·8 to 12	10	10 ounces or 4 wine glasses.
French Clarets ...	6·8 ,, 12		
Burgundies ...	6·0 ,, 13·3		
Rhone	8·5 ,, 13·5		
Strong Wines—			
Madeira... ...	17 to 21	20	5 ounces or 2 wine glasses.
Port	17 ,, 22		
Sherry	16 ,, 24		
Spirits—			
Gin	40 to 60	50	2 ounces 1 small wine glass.
Whisky	50 ,, 60		
Brandy	53 ,, 60		
Rum	60 ,, 75		
Home-made Wines—			
Cider	These all vary very much, and are sometimes so strongly fortified, as to lose the character of wines.		
Perry			
Elder			
Gooseberry ...			

It is worthy of note that **spirits** are, in all cases, dangerous, unless used with large quantities of water. **Raw spirits** act upon the beautiful delicate lining membrane of the stomach, irritating and inflaming it: they often contain highly injurious substances; for example—fusel oil may be frequently detected in new whisky.

The continued use of an **excess of alcoholic drinks** brings about important changes in the following organs:—

In the stomach, a small quantity may aid digestion; a larger quantity irritates and inflames the mucous membrane, and gives rise to dyspepsia, followed by fatty degeneration of the tissue.

In the liver, enlargement and fatty degeneration are early produced by indulgence in excess of alcohol.

In the kidney, the tubules and blood-vessels become enlarged and congested. The vessels in time become thickened, and their power of contraction is destroyed as the result of alcoholic action.

The lungs become congested by the abnormal dilation of the blood-vessels—chronic bronchitis may result.

The heart becomes enlarged, and fatty degeneration is often set up—that is, fatty matter is deposited between the individual muscular fibres, leading to disease of the whole.

In the case of the action of **alcohol on the brain**, it appears to possess, when used in small quantities, the power of increasing its activity, causing the thoughts to flow more rapidly, and giving a feeling of increased power. This is followed by a marked relaxation, attended by a feeling of extreme exhaustion. The orator and politician, who is thus "primed" for his speech, feels "done up" after the first influence has passed off. It appears that this kind of brain excitation or stimulation is the very worst. It may give rise to a flow of language before unknown to the person. But is it always the most exact language?—is it always even the strict truth? It appears that when one so speaks under the influence of this substance, the thoughts run wild—they, as it were, race on before the words. The address may be flowing, and be adorned with the flowers of rhetoric; but it lacks facts and solid truth—it is like a soap bubble, irradiant in the sunlight whilst it lasts—but an empty bubble and nothing more. The language is not weighed—the words are not measured. In such a case, it may be truly said, the "thoughts run wild."

The limited space at our disposal will not admit of our treating further of this interesting subject here, but we hope to do so in a

larger work; for we have only been able to deal with a very few facts connected with it.

In summing up, then, alcohol does not make us warm, nor does it strengthen us; used as a fattening agent, it is dangerous, and the brain work performed under its influence is not the best.

On the other hand, there may be cases where it is required in small quantities, and may be of use, as in those with weak digestion and poor appetites.

CHAPTER XXII.

THE ATMOSPHERE.

The Air.—Matters poured into it.—Composition of Air.—Nitrogen.—Oxygen.—Carbonic Acid Gas.—Watery Vapour.—Ozone.—Suspended Impurities.—Inorganic Impurities.—Cutler's Lung.—Miner's Consumption.

THE **air.**—On all sides we are surrounded by air, which is, in its pure state, inodorous, colourless, and tasteless, and which therefore, we are apt to forget, because it does not ordinarily produce special sensations, such as those of smell, sight, and taste. Occasionally we are made aware of the presence of this gaseous body, as when the wind blows, when, in other words, air is in motion, or when we move rapidly through it. Now this air is more essential to life than either water or food; deprived of it for only a few seconds we must die.

Matters poured into the air.—This gaseous body then is necessary for our very existence; we breathe it, and at every breath pour into it a certain amount of poisonous matter. The waste solid and liquid matters thrown off from the body find their way generally, as the drainage of villages and towns, into rivers. Our general knowledge has reached that point, that we refuse to drink, and regard as repulsive, the waters of such rivers as have received these waste products, until they have been thoroughly purified. We even adopt means within our own homes to purify the water we use for drinking purposes. Little thought is generally given,

however, to the decaying waste matter that is every second being poured into the air. Frequently sleeping and living rooms are so badly ventilated, that this poisonous matter is breathed and re-breathed, until *head-ache, lassitude, sickness, disease, and death result.*

In studying the subjects of **breathing** and **ventilation**, it will be convenient first to devote a little space to the questions of—How we breathe? and What we breathe?

You will remember that one of the uses of carbonaceous food is to keep up the temperature of the body. This it does when the **carbon and hydrogen** which it contains are **burnt up by oxygen.** The oxygen is furnished to the blood by the air which we take into our lungs.

Composition of air.—Pure air is a mechanical mixture of gases—two chiefly are present—

Nitrogen - - -	77·98 in 100 parts of air.
Oxygen - - -	20·61 " " "

The other substances vary slightly, but they are generally found in fresh, pure air, where impurity is not likely to reach; on hill tops, open places, and in specimens brought down by ballons, etc.

Carbon dioxide (carbonic acid gas) ·04 per cent. or 4 gallons in 10,000 of air.

Watery vapour, quantity varies with temperature, etc.

Ozone, variable.

Ammonia, trace variable.

Nitric acid, trace variable.

Nitrous acid, trace variable.

Suspended matter, variable.

In large buildings, towns, etc., where men or animals are congregated together, the proportion of carbonic dioxide, ammonia, suspended matter, and other even more dangerous impurities, are considerably increased.

The **Nitrogen** of air seems to act as a diluent of the oxygen, reducing its strength and preventing its rapid action. An animal

will live only for a short time in pure oxygen. The nitrogen of air may serve to furnish plants with a small quantity of nitrogenous food; for when the electric discharge takes place in air, some nitrogen combines with oxygen to form oxides of nitrogen, which are washed down by rain into the soil.

Oxygen is the most important gas present in air—it is necessary for all forms of living things—animals deprived of it die at once. It is necessary for all kinds of combustion—the burning fuel in the grate, the gas, the oil of the lamp, the fat of the candle, all alike rob the air of oxygen.

Carbonic acid gas (CO_2) is produced when carbon combines with oxygen. This oxidation of carbon is always accompanied by heat. The carbon may be furnished by the fat of a candle, the coal or coke of the fire, the paraffin of the lamp, or the heat producing foods of the bodies of animals. In all these cases the oxygen is used up, and carbonic acid gas results. This gas is given out in the breath of animals. It is well to remember that it is breathed in by plants, they retain the carbon and set free the oxygen, which escapes into the air. Hence the plant purifies the air by absorbing this poison. Plants can only do this under the influence of sunlight, for in the dark they take in oxygen.

Watery vapour is always present in the air. It is given out in the breath of animals, exhaled by plants, and it is given off from all exposed water on the earth's surface. The presence of watery vapour in the air is absolutely necessary for the life of plants and animals. Dry air absorbs the moisture from the structures of living things, and they soon die.

Ozone is a condensed form of oxygen, which is produced when the electric discharge takes place in air. It is a powerful oxydising agent. Very small quantities of it are found in pure fresh air over or near the sea, in elevated places, and in districts far removed from towns. In such small quantities does it exist in the air of towns and cities that it becomes exceedingly difficult to prove its existence. About 1 part in 700,000 is present in fresh country air.

Ammonia is given off from all decaying nitrogenous matter. It is washed down by rain into the soil, and is a valuable food for plants.

Nitric and **nitrous oxides** are produced in the air by the direct combination of nitrogen and oxygen during the electric discharge. These are washed down by rains and carried into the soil and serve as food for plants. Small quantities of oxides of nitrogen are probably derived by air from decaying nitrogenous matter.

The suspended impurities which are present in small quantities only in *pure air*, but often in large quantities in *ordinary air*, are the most dangerous, and therefore we will devote a few lines to them.

They may be divided into two classes—**inorganic** and **organic impurities**; the latter are generally the more harmful.

Those of **mineral** or **inorganic origin** are such as fine particles of *common salt*, *chalk*, *phosphate of lime*, *clay*, *sand*, *carbon*, *coal*, and *oxide of iron*, and in factories the fine dust of the special articles employed in manufacture.

The disease known as **saw grinder's consumption** is produced by the fine dust of iron breathed into the delicate air passages of the lungs: here they mechanically irritate the lungs, and give rise to the appearance known as **cutler's lungs.** As the amount increases, general disease of the lungs follows. Saw grinders, knife sharpeners, and needle makers were, some few years since, very much subject to this disease. In many cases, now, large magnets are used to attract the dust, and happily the disease is not so common.

Miner's consumption is produced by the fine particles of coal dust breathed by these workers. The dust is deposited in the lungs, and gives rise to the diseased condition known as **collier lung.**

Potter's asthma is produced by breathing fine dust of clay. The particles being deposited in the lungs, so irritate the tissues, as to give rise to an asthmatical cough

In match factories, the particles and fumes of phosphorus, when breathed, give rise to a fearful disease—*necrosis*, or death of portions of the upper and lower jaw-bones.

The dust of lead, in white lead works, produces lead colic, etc.

The workers in copper and brass foundries are subject to founder ague; and so on through the whole list of them; the dust, in each case, being peculiar to the manufacture, and giving rise to characteristic diseases when breathed.

The **organic impurities** vary much with the locality both in quantity and kind. Those which are common are—*scales of skin, hair, splinters of wood, small fragments of flax, wool, cotton, silk, fatty particles, starch cells, pollen grains, small seeds*, and *disease germs.*

Most of these are comparatively harmless when the air is inspired through nature's respirator—the nose.

The disease germs, ever floating in the air, may, under certain conditions, give rise to phthisis, glanders, erysipelas, typhus and typhoid fevers, small pox, and other epidemic diseases.

"The germs in the air," says Professor Tyndall, "differ widely among themselves as regards *preparedness* for development. Some are fresh, others old; some are dry, others moist. Infected by such germs, the same infusion (or water) would require different lengths of time to develop *Bacterial* life. This remark applies to the different degrees of rapidity with which epidemic diseases affect different people. In some, the hatching period, if I may call it such, is long; in some, short; the differences depending upon the different degrees of preparedness of the contagion."

When these disease germs adhere to our food, or fall into the water we drink, they become especially dangerous. Professor Tyndall says—"The germs of the air being more or less desicated, require a period of preparation more or less long, to bring them to the starting point of water germs. In water, they are already wetted, and ready, under the proper conditions (such as those afforded by the heat of the body) to pass into the state of perfect organism."

For more complete information on this subject, the reader may refer to Professor Tyndall's "Dust in the Air."

CHAPTER XXIII.

BREATHING.

How we Breathe.—Why we Breathe.—Change the Air undergoes in the Lungs.—How the Air is rendered Impure.

BREATHING, **or respiration.**—The air which we inspire passes down the wind-pipe into the lungs, and then into the most minute air cells, or bags, of which the whole substance of the lungs is composed. On the outside of these air bags, there are distributed little networks of blood-vessels. Some of the vessels contain dark red, impure blood, charged with carbonic acid gas and other impurities. A part of the oxygen of the air in the small cells passes through the thin and delicate wall of the air vesicles into the blood-vessels, and some of the carbonic acid gas and water of the impure blood passes into the air contained in the air cell, rendering it impure. By this means the dark red blood is changed in colour, and becomes bright red or scarlet.

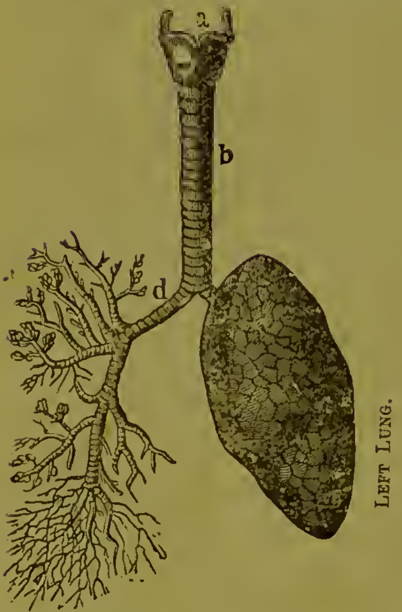


FIG. 18.—LEFT LUNG AND RIGHT LUNG DISSECTED IN ORDER TO SHOW THE BRONCHIAL TUBES.
a—Larynx. *b*—Trachea. *d*—Right Bronchus, ending in Bronchial Tubes.

The **oxygen** taken up by the blood is carried through the whole of the body, and in **all parts it combines with carbon and hydrogen,**

producing heat. When oxygen combines with the carbon of the tissues, carbonic acid gas is formed; and with hydrogen, water is

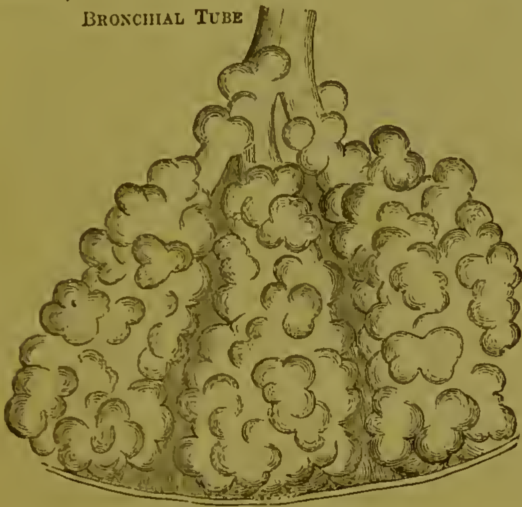


FIG. 17.—SHOWING THREE INFUNDIBULA ON THE ENDS OF THE ULTIMATE BRONCHIAL TUBES, AND THE AIR CELLS BULGING OUT UPON THEIR WALL, GIVING THEM SOMEWHAT THE APPEARANCE OF A BUNCH OF GRAPES.

produced: the blood is thus again changed in colour and rendered impure.

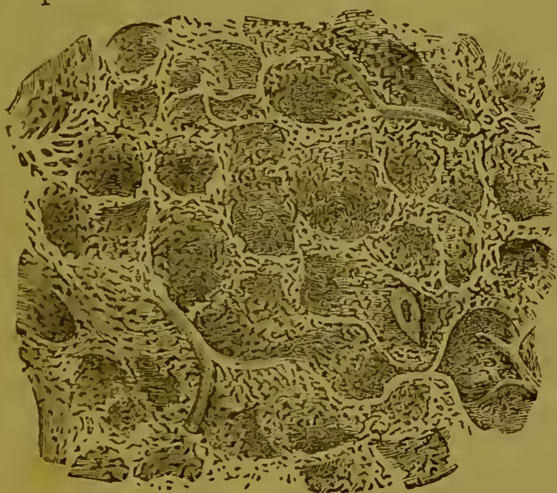


FIG. 18.—SHOWING THE CAPILLARIES AND SMALL ARTERIES OF THE AIR-CELLS OF THE LUNGS. (Very highly magnified.)

In the course of the circulation it is again brought to the lungs, the excess of carbonic acid gas and water are got rid of, and it is purified. During life, therefore, the blood is continually being rendered impure in all parts of the body, and purified in the lungs.

You will understand the danger, then, to which we are exposed

in breathing impure air, and how it may be the means of conveying to the blood poisonous matters.

By the means above described the animal heat is maintained, and it is obvious that oxygen—taken from air—and the carbonaceous matter obtained from food are both essential. This slow combustion or burning up of carbon and hydrogen, which is always taking place during life in all the tissues, keeps the body at a temperature of about 98° Fahrenheit.

The breath.—The air inspired contains about 79 per cent. of nitrogen, 21 per cent. of oxygen, and 4 parts in 10,000 of carbonic acid gas. The air expired contains 79 per cent. of nitrogen, about 16 per cent. of oxygen, and 3 or 4 per cent. of carbonic acid gas. The balance consists of organic matter and watery vapour. We learn, then, that pure air taken into the lungs loses about *one-fourth* of its oxygen, and that carbonic acid gas in the air expired is increased *100 times;* the amount of increase in organic matter and watery vapour being variable.

The changes the air undergoes in the lungs, therefore, are as follows :—

1. *Oxygen diminished about one-fourth.*
2. *Carbonic acid gas increased about one hundred times.*
3. *Watery vapour increased.*
4. *Ammonia and organic matter increased.*

Although air which has been only once breathed contains 16 per cent. of oxygen, which is more than the amount required from air in the lungs, yet it soon loses its power of supporting life.

Air mixed with $\frac{1}{10}$ of its bulk of pure carbonic acid gas may be breathed, and is capable of supporting life; but when only $\frac{1}{200}$ of carbonic acid gas is associated with organic impurities, as it is in expired air, it becomes quite unbreathable.

A healthy adult man breathes from fourteen to eighteen times per minute. The total quantity of air which passes into and out of the lungs in 24 hours is 686,000 cubic inches. This amount is, however, largely increased by exertion, and may, in the case of a

hard-working healthy labourer, reach 1,568,390 cubic inches in the same time.

The quantity of **carbonic acid gas** given off in twenty-four hours amounts to nearly *fourteen and a half cubic feet.* This quantity could only be produced by burning nearly half a pound of pure charcoal or carbon. The **watery vapour** given off in the same time varies—the average amount being *nine ounces.* The average quantity of **organic matter** given off by the lungs in a day is *thirty grains.*

Danger of breathing impure air.—The "closeness" or "stuffiness" of rooms or dwellings is due to carbonic acid gas and organic matter present in the vitiated atmosphere. In crowded, ill-ventilated rooms, halls, theatres, churches, and all other places where large bodies of people congregate, the atmosphere soon becomes poisoned. Most marked and immediate bad effects are produced by such air upon those breathing it. At first it gives rise to quickened respiration; an involuntary effort is thus made to supply the blood with more oxygen by taking more air, this is followed by decreased pulse, langour, sighing, sleepiness, headache, sickness, faintness, stupor, and even death, if relief is not obtained in the form of purer air.

By breathing and re-breathing the same air, we not only deprive the blood of the necessary oxygen, but we also positively add poison to it. Nothing is more common than for crowds to remain in badly ventilated churches and other public buildings, breathing polluted air—the consequence is that the weak faint; in the case of the strong, frequently only a sleepy sensation is induced. It is the imperfect ventilation, or total want of it, which often make children listless and sleepy in school; and the sleepiness which often steals over the children of an older growth in church, is not altogether to be ascribed to the drowsy and monotonous nature of the discourse.

We have seen, then, that injury may be done *suddenly*, and evidently, a far greater injury is being done *gradually*, but not less

surely, to those who spend their days in hot, crowded workshops or offices, and their nights in small close rooms—in both of which alike there is, as a rule, no pretence even at ventilation.

Continued breathing impure air lowers the tone of health, and produces a general predisposition to disease. Those diseases which affect the lungs, such as consumption, may be directly or indirectly produced by breathing foul air. There is no doubt that diseases such as scrofula and consumption are due far more to the poisoned air breathed in our homes and workshops than to our changeable climate.

Careful inquiries conducted some years since by Dr. Parkes and others into the health of the army and navy, brought home the fact that the high death-rate among our soldiers and sailors was due in a great degree to the foul air which they breathed. About thirty years since, consumption in its many forms killed eight out of every thousand of our soldiers annually. It was conclusively proved that the poison-laden air of badly ventilated barracks, small and improperly ventilated and over-crowded sleeping rooms, was the cause at work producing such fearful effects. Happily these evils have been in a great measure remedied, for consumption claims as its victims now, only about two per thousand of our soldiers annually.

CHAPTER XXIV.

VENTILATION.

How the Air is rendered Impure and Unwholesome.—Quantity of Air Required by a Healthy Adult.—How to Change the Air.—Size of Inlet.—Rate of Flow.—Ventilation, Natural and Artificial.—Character of Good London Air.—Air Current in a Warm Room.—Essentials of Good Ventilation.—System of Ventilation.—Hints on the Ventilation of a Room.—"Colds," how to test the Quality of the Air.—Practical hints on Ventilation of the House.

Having learnt something of the nature and amount of the impurities which are continually poured into the air in twenty-four

hours by a healthy adult, we have next to learn how these may be got rid of by ventilation, and how the necessary fresh air with its oxygen may be supplied.

The air is rendered impure, and injurious to those who breathe it—

By over-crowding.

By gas, open coke, and other fires.

By defective drains.

By general dirtiness of clothes and houses.

By injurious matters given off from factories.

By dirt and dust on furniture.

By want of ventilation.

Quantity of air required.—If we wish to live the healthiest lives, the air in our houses should not contain more than **six parts** of carbonic acid gas in 10,000, that is **two parts** in 10,000 over and above the ordinary average amount in pure air. Now, in order to keep the quantity of carbonic acid gas below six volumes in 10,000, it is necessary to adopt some measures for changing the air. We must devote our attention, then, to the questions of size of rooms, and means of promoting circulation of air.

It has been estimated that every adult requires at least 1,000 cubic feet of space to live in. This would be represented by a room 10 feet square and 10 feet high; into this room there should pass 3,000 cubic feet of air every hour, or in other words, the 1,000 cubic feet of air in the room should be changed three times every hour. If, now, we compare these numbers with the conditions under which we generally live, we shall find that either our rooms are insufficiently supplied with air, or they are too small to comply with the above conditions.

It would be inconvenient, to say the least, to seek to renew the air three times each hour by opening all windows, etc., we must therefore adopt some other means to secure the required result.

From practice we have learnt, that a current of air travelling into and out of a room at the rate of 5 feet a second, will secure

the desired change in the body of air in the room, without producing any unpleasant draught. An opening into the room 12 inches by 2 inches, or 6 by 4, through which such a current passes, will admit in one hour 3,000 cubic feet of air, the amount required by one adult. To make the matter clearer: an opening 12 inches by 2 inches would measure 24 square inches; now this is $\frac{1}{6}$ of a square foot. Suppose a current travels through such an opening at the rate of 5 feet per second; in one second $5 \times \frac{1}{6}$, that is $\frac{5}{6}$ of a cubic foot of air, will have passed through the opening, therefore in one minute $\frac{5}{6} \times 60$ or 50 cubic feet, and in one hour 50×60 or 3,000 cubic feet of air would pass into the room by such an opening, which is the amount required.

Ventilation is spoken of as natural and artificial, and we shall learn something of the best systems to adopt in ventilating by glancing at Nature's plan.

Natural removal and interchange of the air is brought about by means of air currents or winds, which are produced by inequalities in density. When air is heated it expands, becomes lighter, and consequently rises above the colder and heavier air. Why does tobacco smoke ascend? Because it is warm, expanded, and light in comparison with the surrounding air. Hold a piece of smouldering brown paper beneath the shade of a lamp, the smoke will ascend into the globe or shade, and leave at the top, floating away with the warm and light currents of air.

It is by means of winds and imperceptible air currents—for, on the calmest day, the air is in motion—that Nature provides for the removal of the waste and effete matters poured into the air; these currents are brought about by changes in density produced by heat. By such currents the air of this great London is renewed. What an immense amount of impurities must be poured into the air by its nearly five million inhabitants, and probably half as many horses and other large animals, to which must be added a large quantity of carbonic acid and other impurities, continually given off in the burning of fuel, gas, etc. Yet, on a clear day in the open street,

so thoroughly is the change and circulation brought about naturally, that the proportion of carbonic acid gas seldom exceeds 4 parts in 10,000.

A very simple experiment will make quite clear the fact of this natural removal of air. In a room in which gas is burning and the doors are closed, some of the air becomes impure, heated, expanded, lighter, and therefore rises to the higher parts of the room. From thence it tries to escape. Hold a burning candle before and close to the opening at the upper part of the door; if the door does not fit very tightly, the flame will be driven outwards through the crevice, proving that a current of air is flowing from the room outwards in that direction. Secondly, hold the candle flame close to the opening at the lower part of the door, and the current blows the flame inwards. This proves that cold air is flowing into the room, to take the place of that which has passed out.

Thus, naturally, impurities may be removed if we only open our windows and doors; but, although this may be good at times when we wish to flush our houses with fresh air, yet it does not constitute ventilation in a strict sense. In such cases draughts are produced, and they must not be confounded with ventilation; for ventilation is defined as the gradual and imperceptible change of air, which prevents the carbonic acid from increasing above 6 parts in 10,000.

The essential points of all good ventilation consist in :—

1. The change must be sufficient to keep the carbonic acid gas below 6 parts in 10,000.

2. The change must be of such a nature that draughts are not produced. Cold air allowed to enter the room at the floor level thoroughly mixes with the air and effectually ventilates the room, but currents so introduced chill the feet and are inconvenient.

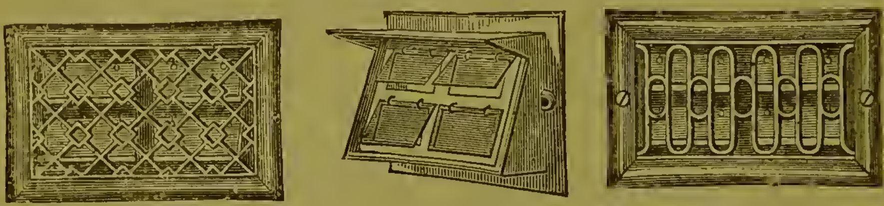
Systems of ventilation.—There are many good forms of ventilators now in the market. Amongst the best to which our limited space will allow us to call attention, are those of Buchan, Boyle, Banner, and McKinnell.

One of the simplest forms of ventilation is that of fixing valves

in the walls of rooms near the ceiling, which will allow the heated impure air to escape into the chimney.

A system was introduced by McKinnell in 1855, in which means were provided for leading air into and out of the room by means of two concentric tubes—one inside the other, and open to the external air. The heated, impure, or vitiated air passes along the central tube, and is conducted out of the building. The pure external air flows in through the space between the outer and inner tubes, Both of these are provided with valves, by means of which the air currents may be regulated. The mouth of the outer one, through which the pure air is admitted, is provided with an appendage by means of which the air is spread out and draughts prevented.

Boyle's mica valve ventilators, for windows or chimneys, are very useful. They consist of a number of small mica plates, so suspended in a frame that the slightest current causes them to move outwards, and allow the egress of the heated air from the



FRONT VIEW. BACK VIEW. FRONT VIEW.

FIG. 19.—BOYLE'S MICA FLAP VENTILATOR (OUTLET).

upper part of a room; the entrance of air is prevented by the reason of the mica flaps being so thin and light, that the smallest current of air, moving in the opposite direction, closes them, and pushes them against the frame, thus preventing the inrush of smoke, etc., when they open into the chimney.

As before explained, not only is it necessary to provide an outlet for the impure air, but an inlet also for the pure air. Boyle's inlet consists of an opening in the external wall, which is provided

with a circular revolving metal plate, by means of which, the amount of air may be regulated.

One of the most important points in good ventilation necessitates the continuous change of air without draught. This object is well secured by **Boyles' Air-pump Ventilator,** which, being self-acting, is well adapted for dwelling-houses, schools, and large public buildings.

This ventilator, shown in Fig. 20, consists of four sections shown in Fig. 21, each acting independently of the other. The figure 1 in plate 21 shows in section a curved baffle plate or guard to concen-

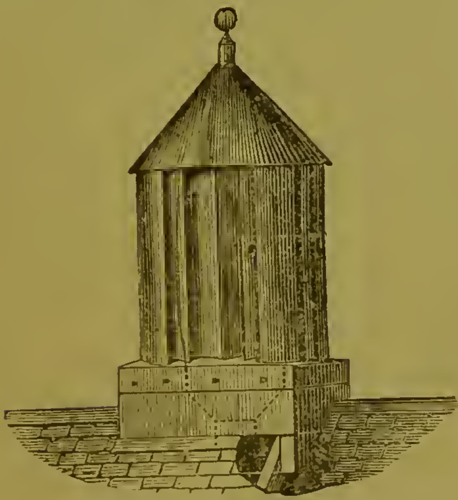


FIG 20.

FIG. 21.

trate the current, and prevent the wind blowing through the slits opposite. Figure 2 shows a curved plate to take the pressure off the vertical slits communicating with the internal chambers, and to prevent down draught. The external air impinging on the diaphragm 3, is deflected on to the central radial plate 4, creating an induced current, and in its passage drawing the air from the vertical chamber 5, expelling it at the opposite opening. The foul air immediately rushes up the shaft connecting the ventilator with the apartment being ventilated, to supply the place of the air extracted, thus securing a continuous and powerful upward current.

Figure 6 in the same plate shows the partitions separating the chambers and preventing external air being drawn through the slits upon which the wind is not directly acting.

In order to secure good and thorough ventilation in cold weather, it is necessary that the air should be warmed before it enters the room. A very simple, yet effective, means of warming the air admitted into the chamber has been devised by Messrs. Boyles & Son. Its application and construction will be best understood by reference to the diagram given next page.

The air-warmer is intended for warming the fresh air supplied to a building where hot air, water, or steam pipes are not available. The arrangement consists of a copper or iron pipe about 1½ in. diameter, placed in an inlet tube, preferably of the form of a bracket. This pipe is made of zigzag shape, so as to cross and re-cross the tube from top to bottom, causing the incoming air to repeatedly impinge upon it in its passage through the tube. At the bottom of the tube an air-tight chamber, so far as the interior of the tube is concerned, is fixed, in which a "Bunsen" burner is placed, the flame of which plays up into one end of the pipe which is connected with the top of the chamber. The heat travels through the entire length of the pipe, the other end of which may be made to either dip into a condensation box in the bottom of the tube, or be continued as shown by dotted lines in the accompanying diagram, up into the flue or extraction shaft. If the pipe terminates in the box, the vapour is condensed there and carried off through the outside wall by means of a small pipe, and any products of combustion which may arise are absorbed and rendered innocuous by passing through a loose bed of charcoal which covers the bottom of the box. The charcoal should be renewed about once a fortnight or month, according to the extent the tube is used. The diagram given (Fig. 22) shows the arrangement, which is explained as follows:—A, air inlet tube or bracket made of galvanized iron, and painted; dimensions, 24 in. by 16 in. by 6 in. These tubes can be treated ornamentally to harmonise with the decorations of the

room, and where necessary may be placed in chases in the wall. The top of the tube should stand 5 ft. 9 in. from the floor. B, copper or iron tube, $1\frac{1}{2}$ in. diameter; C, chamber containing the burner; D, Bunsen-burner; E, opening covered with perforated zinc in side of tube communicating with chamber for the purpose of supplying air to the burner; F, small hole fitted with sliding shutter, through which the gas is lighted; G, condensation box; H opening in bottom of box to allow of the circulation being maintained in the heating pipe; J, pipe for carrying off condensed vapour; K, continuation of pipe into flue or extraction shaft; L, movable bottom to flame-chamber for purpose of cleaning tube.

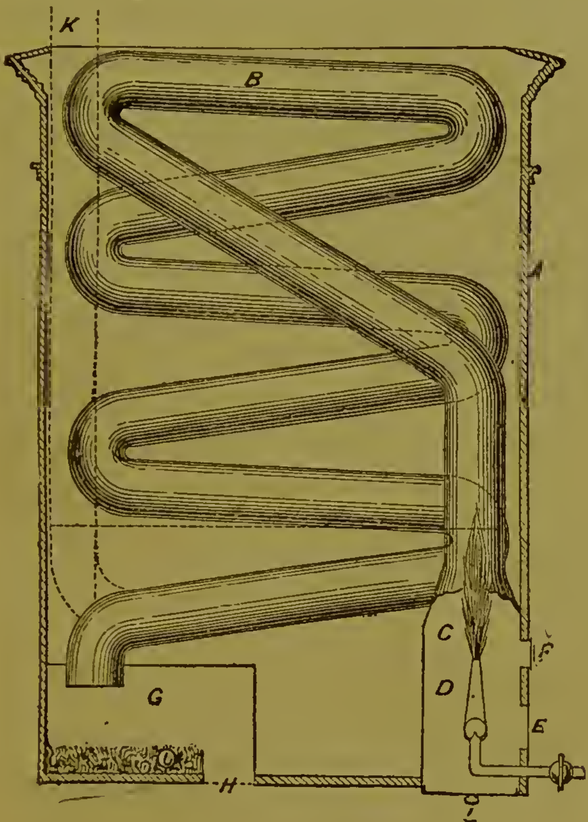


FIG. 22.

Where the tubes are placed against woodwork, all chance of fire may be avoided by fitting them with a double casing or jacket, and filling in the space between with asbestos or other non-conducting material. With this arrangement, the air supply can be raised from a temperature of 30° to 130°, and to show that it is one of the most economical methods of heating in existence, it is only necessary to mention that the cost of gas consumed to raise the incoming air from a temperature of 40° to 100° is less than one

farthing per hour, this being effected with the air passing through the tube at a velocity of 300 feet per minute, or 18,000 feet per hour.

Where difficulties occur in bringing about an exchange of pure air for impure air, as in large buildings, in mines, ships, etc., some form of **artificial ventilation** may be resorted to. The removal of foul air may in such cases be brought about by using some mechanical means either to induce air to enter, or to leave the room or building. In the former case, where measures are taken to drive air into the building, the method of propulsion, or *plenum system*, is adopted; in the latter the air is drawn out by aspiration, on the *vacuum plan.* In some cases a combination of both systems is resorted to. Artificial ventilation may also be brought about by securing an interchange of pure for impure air by employing various special forms of heating apparatus.

Hints for the ventilation of rooms.—There are a few simple ways in which our rooms may be easily ventilated :—

Firstly, as the chimney is in many houses the only ventilating shaft, it should be left open, so that air may pass out.

Secondly, the window is a ready means of ventilation, and may be left open an inch or two. When the draught is great, the space should be covered by a long strip of fine iron wire gauze, or muslin. Another plan is to raise the lower sash, say three inches, and insert a long piece of wood, which will reach from side to side of the frame, so that the sash, when drawn down, will rest upon it; the result will be, that the top of the lower sash is raised a few inches above the bottom of the upper sash, so that a current of air passes through, between the two sashes, in an upward direction, and spreads out in the room. Another good plan, suggested some

years since, is to cut away a little of the window sash on either side of the spring fastener; through the opening thus provided, air passes into the upper part of the room, spreading out without giving rise to a draught.

The frame where the sashes meet may be perforated with five or six auger holes, which will allow a current of air to enter when the window is shut.

· Leave your bed-room window open a little at the top, during the night, if no other means of ventilation are provided; about two inches in winter, and a little more in summer, will generally be found sufficient; of course the extent to which it may be left open with safety depends upon the size of the room, condition of air, etc. Some will urge, why open our bed-room windows? we always sleep with the room doors open. When the door is open, you only have the impure air from the lower part of the house, whilst, if the window is opened, you take in the purer external air. The close, and absolutely offensive, odour that one encounters on entering a bed-room, in which the windows have been closed all night, and the chimney stopped, tells how great is the need for ventilation. If you feel a draught when the window is open at the top, fasten a piece of wire gauze, or muslin, across the opening; this will split up the current of air into a number of smaller currents, and you then cover the difficulty. Think of how much of our time we ordinarily spend in bed, and you will fully understand the importance of taking means to insure a supply of pure air. If, up to the present, you have not slept with the window open at night, and your bed-room is not provided with other efficient means of ventilation, to-morrow morning, leave your room, close the door, go out into the fresh air for ten minutes, and return to the bed-room, to be disgusted with the smell of the atmosphere; you will probably, then, be able to account for the drowsiness, head-ache, and tired feeling that you have experienced often in the past. You may remember having repeatedly risen from your bed only slightly refreshed, with a feeling of languor, and inability for work, which has worn off

during the morning when you have bustled about, and breathed purer air. Resolve, therefore, to adopt some means of thoroughly ventilating your bed-room at once.

One-half the "colds" are produced by sleeping in unhealthy, badly-ventilated bed-rooms. The main cause of the same is the result of the disturbance produced in the system by constantly breathing impure air; thus the susceptibility to colds is produced, and cold currents may finish the work. Those who live in pure air need not fear cold air, for it has little power in itself to produce disease. If our theatres, concert halls, ball-rooms, and churches were better ventilated, it is certain that there would be less complaints by those visiting them of sudden, severe, and even fatal colds, caught after a visit.

How to test the air in a room.—To test whether the air in a room is pure and fit to breathe, go into it after being in the open air for five or ten minutes. If the chamber has a close and stuffy smell, the air is impure. The following plan, proposed by Dr. Angus Smith, is exceedingly simple and very good:—Take a clean transparent glass bottle, of about 10½ ounces capacity, cram into it a clean dry linen cloth, then take it into the room the air of which you wish to test; pull out the cloth, then air rushes in to supply its place; you have now a bottle full of air to examine. Add to the bottle ½ an ounce or a tablespoonful of clear lime water, and shake it up; if the lime water becomes milky there is an excess of carbonic acid gas present. It is well to remember that the amount of carbonic acid gas is a very good index of the amount of other impurities.

If you take a similar bottle to that mentioned in the last experiment, and fill it with air as before, to be tested, then pour into it one ounce of Condy's fluid of a pale rose colour, and shake well; if the colour disappears, an excess of organic matter is present. This test is not exact, although true in ordinary cases, for other substances than organic may be present in the air and produce the same result.

Practical hints on ventilation:—

1. Windows should open top and bottom to the external air.

2. Always air your rooms from the outside, and not from a staircase.

3. Impurity of air is often due to the dirty state of furniture, walls, and floor.

4. When the floor, etc., is washed, the room should not be occupied until it is quite dry.

5. There are two main sources of impurity of air—namely, *combustion* of candles, gas, oil, coal, etc.; and *respiration* of animals.

6. Gas, if used, should not be allowed to burn all night in the bed-room, nor should it be lighted, as is often done, long before it is wanted; for much oxygen is consumed, and the air rendered impure.

7. Do not use the ordinary gas-burner as a means of warming the bed-room.

8. Where gas is used, a separate outlet should be provided for the noxious gases produced, immediately over the light. This outlet should either communicate with the chimney or external air.

9. Do not block up the chimney with shavings or a bag of saw-dust, but leave it open for ventilation.

10. The windows and doors of all rooms should be opened, and the rooms thoroughly flushed with air at least once a day.

11. The window of the bedroom should be opened in the morning, and the bedding spread out, and the un-made bed freely aired.

12. In cold weather, some of the in-coming air should be warmed, in order that enough air is provided without draughts.

13. Avoid hangings and curtains round the bed, they hinder ventilation and harbour the dust. If curtains are used for the windows, they should be of some washable material.

14. Do not put the bed in an out-of-the-way corner of the room, for all irregularities interfere with the free circulation of air.

15. The bed-room should not contain much furniture. All pieces of furniture take up space, and reduce the amount of air in the room, and hinder ventilation.

16. All rooms should be provided with inlets for pure, fresh air, and outlets for impure air, in proportion to their size and the number of occupants.

CHAPTER XXIVb.

REMOVAL OF HOUSE REFUSE.

Necessity for Removal of Refuse.—Conservancy Systems of Removal.—Dry Earth System.—Water Carriage System.—Advantages of Dry Earth System.—Advantages of Water Carriage System.—Objections to Dry Earth System—Removal of Animal and Vegetable Refuse. Dustbins.

REMOVAL of **House Refuse.**—For the health of both the individual and the community, it is important that waste and refuse matters, including excretions from kidney and intestines, waste water which has been used for cooking or washing, organic refuse of animal or vegetable origin, dust and kitchen stuff, should be removed. Such materials allowed to remain near the dwelling soon undergo decomposition, and not only act as a nuisance from the effluvia which they evolve, but also promote the outbreak and spread of disease. In all districts and towns where such matters are allowed to accumulate instead of being got rid of as soon as possible there is a high general death-rate, and the mortality from typhoid fever and epidemic diseases is unusually high. The solid portions of this refuse contain materials which are valuable as manure; it has been, therefore, the general practice to collect these substances with the view of using them for that purpose. The various methods which aim at securing this object are classed as **conservancy systems.** But as rain and waste water could not be

collected and used in a similar way, it was collected in and carried off by drains, into which in time foul solid matters were allowed to flow, hence arose a **water carriage system.**

The following are the various forms of the "conservancy systems":—*The cesspool system, the pail system, the midden system, the dry earth system.* Of these the best is the "**Dry Earth System,**" in which case the excreta is received in, and mixed with, dry earth by which it is rendered inodorous. It has been found that $1\frac{1}{2}$ pounds of dry loamy earth furnish the best deodorising material for each ordinary evacuation. The earth used must be kept thoroughly dry, otherwise the received excreta undergoes decomposition, and the receptacle becomes a cesspool. This system is of value for out-door use, where large bodies of people are temporally collected, where the water supply is scanty, where the climate is such that water would freeze for long periods, and where a sufficient fall cannot be obtained for sewers. Whatever dry method may be adopted sewers are required to carry off waste water, and in large towns at least it becomes impracticable to supply sufficient dry earth for the method to be efficient, the water carriage system for such is therefore preferable. It is urged as an objection to this system, that the excreta is not continuously removed, but is kept in or about the house for some time; and, further, although the initial cost incurred by the water carriage system is greater, yet the constant expense involved in use of dry earth, removal, utensils, etc., is even greater.

Under the **water carriage system** the solid excretal refuse is washed into the sewer with foul and waste water. The objections which have been raised against this system are chiefly such as are the outcome of defects in engineering and imperfections in workmanship. In some cases, inasmuch as a large quantity of water has to be used for flushing closets, it becomes difficult to dispose of the bulk of dilute sewage thus produced; therefore in large towns far removed from the sea or great rivers a combined system of dry earth closets, with separate sewers for foul water, is preferable.

The Dustbin should be used only for dry dust and ashes from the fire. All animal and vegetable refuse should be speedily removed from the neighbourhood of the dwelling or burnt.

CHAPTER XXV.

THE SKIN AND ITS WORK.

Structure of the Skin. - Epidermis. — Waste of Scarf Skin. — *Rete mucosum.* —*Dermis* or True Skin. — Fat Beneath the Skin. — Muscles of the Skin. — Loss of Heat by Skin. — Sweat Glands: their Work. — Insensible and Sensible Perspiration. — Hair. — Nails. — Care of the Nails.

THE delicate structures of the body of man are protected from rude contact with external objects by a tough yet sensitive and elastic covering known as the skin. Not only does the skin invest and protect the whole of the body, but it has other distinct offices or functions to perform. The nature of these functions, and how a healthy activity of the skin may be promoted, also the way in which it may be prevented from becoming diseased, will next be the objects of our study.

Structure of the Skin.—Simple though the skin may appear to be, it is really complicated in its structure, being composed of three layers.

Firstly, there is an outer hard, horny layer, which contains no blood-vessels or nerves. This is known as the **scarf skin** or **epidermis**. It is composed of an infinite number of small, thin, horny plates or scales, laid one on top of another, and firmly attached, except on the surface, where they become gradually loosened, and are constantly being cast off. Every time we rub any part of our body immense numbers of these flattened cells are removed, hence it is very important that we should keep the *whole* of the skin clean. The shedding of the outer layer of the exposed

parts of the skin is nearly imperceptible in health. The cloud of fine white dust which flies off when any article of clothing from next the skin is shaken, after having been worn a few days, consists mainly of the old and worn-out horny scales. This horny layer serves to protect the delicate layers of the skin beneath.

Secondly, underneath this hard layer, the skin is soft, and made up of little rounded bodies known as cells, which contain colouring matter called pigment. The colour of the skin, brown, olive, black, or white, is due to the shade, or tint, of these pigment cells. This layer of the skin is known as the **rete mucosum.**

Thirdly, beneath the rete mucosum, we find **the true skin**, or **dermis.** It is this part of the skin of the lower animals which, when tanned, makes leather. The dermis is composed of fine, closely interlacing fibres, of elastic tissue, with which are interwoven an immense network of small blood-vessels and nerves. The layer in contact with the rete mucosum is denser than the deeper layers. In the more open and looser layers beneath, the roots of the hair, and active parts of the sweat glands, are situated. In dropsy, water accumulates in the spaces occurring in the deeper layers of the true skin.

In consequence of the rich nervous and vascular supply of the true skin, it is highly sensitive, and bleeds copiously when cut. If, by accident, a piece of the epidermis has been removed, acute pain is felt whenever any object comes in contact with the exposed dermis.

The surface of the true skin is not smooth; but it rises intoa number of prominences, which contain the ends of small nerves. These projections rise into the rete mucosum, and so bring the ends of the nerves nearer to the surface.

Beneath the dermis is a layer of loose cellular and fatty tissue. This fat serves to fill up irregularities, giving smoothness, roundness, and plumpness to the body. It acts as a pad, protecting the structures beneath, and, owing to its non-conducting power, it keeps in the heat of the body.

The structures belonging to the skin may be divided into—firstly, the skin proper; secondly, the glands which it contains, which secrete oil, or perspiration; thirdly, the appendages—the hair and nails.

The muscles of the skin.—Distributed through the skin, there are immense numbers of small involuntary muscular fibres. These are, of course, not under the influence of the will, but contract and relax in response to alterations of temperature, or under the influence of nervous excitement. Fear so acts upon the nerves connected with these muscles, that it causes their contraction, and the face or limbs become blanched. Some are so disposed, that when they contract, they cause the prominences from which the perspiration flows to close, and hence check the outflow. Others are so placed, near the hairs and hair glands, that when they contract, they make the hairs stand up. Horror, or fright, will sometimes so influence the nervous system, that small nerves acting upon these muscles make the "hair to stand on end." Shakespeare put the following words into the mouth of the Ghost in "Hamlet :— "

> "*I could a tale unfold, whose lightest word*
> *Would harrow up thy soul, freeze thy young blood,*
> *Making thy two eyes, like stars, start from their spheres;*
> *Thy knotted and combined locks to part,*
> *And each particular hair to stand on end,*
> *Like quills upon the fretful porcupine.*"

When the surface of the body is exposed to cold, these little muscles, acting together, contract in all directions, and force the blood from the surface. In this way the amount of perspiration is diminished, and necessarily the amount of evaporation and loss of heat from the surface of the body, is also decreased. On the other hand, when we exert ourselves, or expose our bodies to great heat,—either from the sun's rays, or at a Turkish bath, etc.,—these muscles relax and allow more blood to flow to the surface; then the sweat glands become very active, and the amount of perspiration is very much increased. The evaporation of the sweat and drying

of the surface of the skin means that heat is extracted from the body, and in this way the normal temperature is maintained. In health, the temperature of the body is about 98 degrees Fahrenheit. In a previous chapter it has been explained how this heat is *produced and maintained* by the combustion of food. We have now seen how excessive loss is prevented in one case, and how on the other hand the temperature is kept down by the loss of heat in the production and evaporation of sweat; in other words, we have learnt how the temperature of the body is controlled by the action of the skin. It is important to remember that the muscular coats of the small blood-vessels referred to in treating of the effects of alcohol, also regulate the amount of blood sent to the skin.

The skin not only acts as a protecting organ, covering all parts of the body, but it is also an **organ of excretion,** by means of which certain waste materials are extracted from the blood, and removed from the body. The active agents in performing this work are the sweat glands, which are small tubes, opening at the surface of the skin.

Each of the **sweat glands** consists partly of a spiral tube, which passes through the first and second layers of the skin, to the true skin or dermis. In the true skin the tube is coiled or rolled up, around which ball of convoluted tube is a network of blood-vessels. The tubes themselves are lined with small secreting cells, which have the power of separating from the blood perspiration or sweat. The mouths of these glands occur very regularly on the surface of the fingers and thumb, and may be easily made out on the ridges with a small magnifying glass. They are commonly known as the **pores** of the body. They vary in number in different parts; for example, one square inch of the skin of the hand contains many more than the same area of the back.

The numbers appear to vary also in different people, but it has been estimated that the average total number of these pores on the whole surface of the body is 2,500,000. The sweat flows along the sweat ducts and passes out of the sweat pores on the surface of the skin.

When your hands are very warm you will be able to see, even with the naked eye, a great number of the little pores on the top of the fingers and thumb, from which the perspiration oozes. The sweat glands are always at work; but generally (although the openings on the surface are free) no sweat can, when the body is at rest and not too warm, be seen to ooze from them. This is in consequence of the spiral arrangement of the outer part of the tube, by means of which the perspiration gradually soaks into, and keeps the horny layer of the skin moist. The matter which thus escapes from the skin is termed **insensible perspiration.** This is largely increased during warm weather, or by violent exercise; in such cases the sweat may exist on the surface of the body in small drops: this is **sensible perspiration.**

From the above we learn how necessary it must be to keep the skin of the whole body perfectly clean, in order that it may properly perform its work. We learn also that this secretion of sweat should not be suddenly checked, for then the blood is driven back to the lungs and kidneys, and they are called upon to do extra work. If, after violent exertion, we expose the body to a cold draught, a violent "cold" or congestion of some important internal organ results. Therefore, after exposure to great heat, or increased muscular work or exercise, we should allow the body slowly to cool down.

The **sweat** consists mainly of water, which contains salts and organic matter.

The second kind of glands found in the skin, termed the **sebaceous glands,** occur in connection with the hair. Most commonly they are found opening into the tubes in which the hairs grow. They secrete an oily or fatty substance termed *sebum,* from the Latin name for suet; which is conveyed gradually to the hair, and so to the surface of the body. The oily matter which oozes from these glands to the surface of the body tends, when allowed to accumulate to decompose, it then gives out a peculiar objectionable odour, which varies in different individuals.

Hair.—The hairs grow from small depressions in the skin called hair follicles. They are absent from the palms, soles, and a few other parts of the body; where they do occur, they vary with the part in different persons.

If a hair is examined by the aid of a microscope, it will be seen to consist of an outer layer of flattened cells which overlap like the tiles on a roof. The hair itself is nothing more than the modified horny layer of the skin, which has assumed a thread-like structure.

The **nails** are plates of horny matter which, like hairs, are produced by the modification of the horny cells of the epidermis. They are firmly attached to the bed or quick upon which they grow. The rate at which the nails grow varies with the age; they grow more quickly in the young than the old; in the same individual, the growth generally appears to be more rapid in summer than winter. Bathing, and frequent washing, seems to promote their rapid growth, but the rate of development does not appear to be uniform on each finger and toe.

It becomes necessary at times to cut the nails, and a few words on the **care of the nails** may not be out of place here. When dirt gathers beneath the finger-nails it should be removed with a soft brush, soap, and water. The common practice of scooping out the nails with a pen-knife, tends to raise them from their beds, and so increase the space in which dirt may accumulate. The toe-nails should be cut nearly square, and the sides carefully cleaned with a soft brush, warm water, and soap. Frequently thickened dead skin accumulates at the sides of the toe-nails, this should be carefully removed by brushing, and not picked out with a knife or scissors. When the latter means are adopted, the dead skin is effectually removed, but the pressure of the boot, generally made too narrow for the toes, forces the nail to grow into a tender and exposed part of the flesh, producing a sore.

CHAPTER XXVI.

HYGIENE OF THE SKIN.

Care of the Skin.—Dirt and the Skin.—Effects of not Washing the Skin.—A Simple Bath.—Substitute for a Cold Bath.

CARE **of the skin.**—The condition of the skin depends upon the quantity and kind of food taken, the treatment to which it is subjected, and the general state of the internal organs. When we think of how much of health and beauty depends upon its good condition, the subject becomes of deep interest to us all.

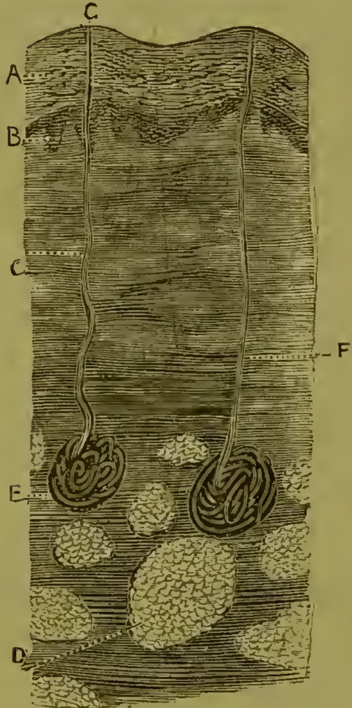


FIG. 26.—VERTICAL SECTION OF THE SKIN.
Highly magnified.

A—Cuticle or Epidermis.
B—Rete Mucosum.
C—True Skin or Dermis.
D—Fat Cell.
E—Sweat Glands.
F—Sweat Duct
G—Sweat Pore.

In health, the skin is always giving out the watery and fatty secretions as before described, and actual solid particles are always being cast off. Now, if the skin is not kept thoroughly clean, the particles of dust around us, the particles worn off from the clothes we wear, the old dead scales set free from the surface,

and the secretions, all accumulate and plug up the little mouths of the glands, preventing them from performing their work. In such a case, a part of the work that should be performed by the skin, is unfairly thrown upon some other organs—the lungs, or kidneys, generally. For a time, these organs may do the extra work, but eventually the health suffers; we should take means, therefore, to secure the thorough removal of these matters by frequent ablutions. The body should be properly cleansed with water, from head to foot, once each day. The scales of scarf skin are constantly being removed by the friction of clothes we wear: but, if we wish to maintain it in a healthy condition, it must be washed and well rubbed frequently.

If the skin is not kept clean, the accumulated matter on its surface often partly decomposes, and gives rise to acrid and strong-smelling compounds. The cold water bath every morning is very bracing and invigorating, and, if well followed up by friction with a large rough towel, is most enjoyable and health-giving. All healthy people should wash in cold water, all over, every morning. Remember, that in summer the temperature of the water delivered to our houses is nearer to that of the body than in winter; also, the body is generally better able to bear the sudden chilling of the cold bath in summer than in winter. In most cases, therefore, it is best to raise the temperature of the water to about 60° Fahrenheit in winter.

The morning cold bath is certainly most refreshing, but is not sufficient cleansing, for water alone will not remove the fatty matter from the skin, other means therefore must be adopted to secure the result. For those who are healthy and wish to keep so, and can afford the time and money, the **Turkish bath** properly and occasionally taken is quite the best way to cleanse the skin. In the hot rooms the skin is relaxed, the amount of perspiration considerably increased, and the sweat glands are cleared. During the shampooing, the scales and accumulated matters are removed from the surface, and the whole skin is cleansed. The bath should

be followed by a cold plunge or shower, which cools down the skin and closes the pores.

Turkish baths cannot be recommended to those who suffer from heart or lung diseases, or those in a weak state of health, in which cases they should only be taken under the advice of a medical man.

A simple morning bath.—The great obstacle in many cases to the morning bath, is the want of room, and the idea that it means money, labour, and time. In securing this essential to health, it is not necessary to go to great expense to provide a costly bath. All that is necessary is a large wash-hand basin, a can which will hold two gallons of water, a small flat-bottomed vessel in which to stand, a large sponge, and a good thick piece of carpet or matting to spread on the floor. With such, a thorough and effectual bath may be secured every morning at little cost. The water should be poured into the large wash-hand basin, the operator should then step into the tub, fill the sponge with water, rub on it a layer of soap, well rub the whole of the body, then rinse the sponge in fresh water, and give the body a douche two or three times from head to foot. Now step out to the mat or towel which has been doubled and placed on the floor, wipe the skin with the dry sponge, and then rub it thoroughly with a long rough towel. The main difference between the above and the ordinary cold or sponge bath is, that soap is rubbed on the sponge. It is the soap which has the power of removing the greasy matter from the surface of the body, and which makes such a bath so effectual and health-giving.

A substitute for a cold bath may be extemporized by dipping a towel in cold water, and thoroughly rubbing the whole body with it from head to toe. This plan necessitates the use of two or three long bath towels—one should be doubled for the operator to stand upon, the second dipped in the water and used to clean the body, and the third for drying. Such an invigorating and refreshing morning wash takes little time, and is within the reach of all.

Where privacy cannot be otherwise secured, as in the homes of

the poorer classes, a corner of the room in which the bath is to be taken may be separated off from the rest by hanging a sheet or curtain from a piece of string, or a cheap paper or canvas screen may be used.

What should be urged on all alike is this—let no ordinary obstacle stand in the way; get your bath for the sake of cleanliness, health, and beauty. In conclusion, bear in mind that a perfectly healthy and active skin means a great deal towards a sound body.

CHAPTER XXVII.

SOAP, AND ITS USES.

The use of Soap.—Good and Bad Soaps.—Toilet Soap.—Medicated Soap.—Pears' Unscented Soap.—Glycerine Soap.—Bathing.—A Cold Bath.—A Warm Bath.—Sea Bathing.—Washing Water.—The Hair.—Baldness, and How Produced.

THE **use of soap** becomes necessary, as explained in the preceding chapter, when we wish to thoroughly cleanse the skin. Those who wish to preserve the skin in good order, and particularly such as are troubled with a tender, and generally irritable, state of this organ, must attend to two things—proper soap and water. We have stated that water alone is incapable of removing the oily matter from the skin. It is generally well known, that in order to thoroughly clean out a bottle which has contained either oil, or an oily compound, it is necessary to make use of an alkali, such as soda or potash. Hot or cold water alone will not remove the oily matter; but if some soda is added to the water, and shaken up in the bottle, a soapy compound is produced, and the layer of oil in this way may be easily removed.

Soap consists of fat or oil, combined with an alkali, such as soda or potash; it also contains a varying quantity of water. There is always present in soap some free or uncombined alkali, and this, when the soap is rubbed with water on the surface of the skin,

renders the oily matters soluble; these, therefore, may then be easily removed.

Good soap must not contain too much soda, for, in some cases, it makes the skin rough, and may cause it to become chapped; nor too much oil, for this would retard or destroy the cleansing power of the soap; nor too much water, for that will make the soap soft, and hence expensive, because it is wasteful.

It is generally known that potash is a more powerful alkali than soda, hence potash soaps are more powerful in their action than those which contain soda. Soft soap contains potash, and when this is used to wash the skin the natural oil is so thoroughly removed by the strong alkali that it becomes dry and harsh. Whoever by mistake or for any reason has used a potash soap to the skin knows that the removal of the natural oil and consequent dryness is attended by the sensation of tightness of the skin—it feels to such an one as if it were too tight. This is a common experience with washerwomen, who use strong soaps in the cleansing of linen.

Good soap should be prepared from pure fat, soda, and water, and should be matured and fitted for use by keeping. It should contain about 15 or 16 per cent. of moisture, 68 per cent. of fatty matter, and 7 per cent. of soda. Such a soap would contain only a small amount of free alkali, and when used would cleanse the skin without entirely removing the oily matter, and would leave it soft and pliant.

All soap should be carefully washed off the skin before it is dried, unless this is done the skin becomes shiny, smooth, and tight, and the adhering soapy matter acts injuriously upon it.

Many soaps contain a large proportion of free alkali, which may act injuriously on delicate skins, and certainly such soaps do not improve the condition of any, although they may not appear to injure hard, strong skins. The greater number of toilet soaps in the market at the present time contain useless and often

mischievous additions; employed to give bulk and to impart colour, or to mask the objectionable odour of the soap itself.

The **toilet soaps** exposed for sale at the present day may be noted for the varieties of colours they exhibit, strong scents, pretty shapes, the elaborate and highly coloured boxes in which they are packed in most cases, the artistic adornments of which are certainly worthy of a far better cause than that of puffing bad soap. The pungent scents often serve only to mask the objectionable odour of the bad fatty matters employed in the manufacture of such soap. The colouring matters added serve to hide the true nature of the soap, and are often in themselves harmful compounds. The least harmful, but not necessarily harmless, of the substances employed in this way are clay and gypsum. The red colour is generally due to vermilion; reddish brown to clay; blue to ultramarine; green to oxide of cromium and arsenic compounds.

Highly coloured, and otherwise bad soaps, are generally put out for the use of the traveller by the keepers of most continental hotels. To make matters worse, this highly alkaline, perfumed, and richly coloured article, is securely packed in a sheet of lead foil. This soap forms a special item on the bill at most hotels. It is advisible, therefore, when travelling on the continent either for pleasure or business purposes, if you value your skin, and for the sake of convenience, to take your own soap. Probably the best that can be recommended is that known as Pears' unscented. Highly coloured and scented soaps are only too often reserved especially for nursery purposes, they should be always avoided, for not only are they generally bad, but they are especially unsuited for use on the tender, delicate skin of babies. A good soap must be prepared from good selected fatty matter, and it must be kept some time after it is manufactured to mature; this means both money and time. It therefore follows that good soap cannot be very cheap.

The essentials in a good soap are the presence of the smallest proportion of alkali compatible with the solution of the fatty matters:

absence of foreign colouring matters, or materials employed to give bulk. Pears' transparent soap fulfils these conditions, and from experience of its use, we are prepared to say that it is one of the best. Most other transparent soaps—and even the good yellow of respectable firms—are pure enough for ordinary purposes, and are certainly to be preferred before the "toilet soaps." In cases of delicate or diseased skins, unless others are used under medical advice, Pears' is the best.

The **medicated soaps** contain tar, carbolic acid, sulphur, mercurious nitrate, glycerine, and such substances. In some cases of skin disease they are of very little value, but in most cases their use is attended with actual harm. Those with hardy, thick, healthy skins may use them like the strong alkaline soaps without any marked injurious result. But for those with delicate or diseased skins they are generally totally unsuited. Sulphur soaps are, for instance, irritating in their action on most skins, and where it has been found that an application of sulphur to the skin is beneficient, that application must be secured in the shape of vapour, in the "sulphur vapour bath."

Glycerine soap is soothing in its action on the skin, and its use is not attended with so much harm as that of the strong medicated soaps. The glycerine does not combine with the fat or alkali of the soap, but is simply mixed with it, and exudes in drops from the surface when it is kept for a time before being used.

There are many toilet soaps sold which are supposed to contain varying quantities of certain substances, which are said to possess healing and beautifying properties, and from which they derive their particular names. For example, we see advertised Rose, Elder-flower, Almond, Mallow, and Honeysuckle soaps. Most of the soaps of this class do not contain a single drop of the substances of which they are supposed to contain so much, and from which their very names are derived.

CHAPTER XXVIII.

BATHING.

Cold Bath.—Swimming.—Warm Bath.—Sea Bathing.—Washing Water.—The Hair.—Baldness.—How to Prevent Baldness.

BATHING.—A bath should not be taken either immediately or soon after a meal. In most cases it is advisable to allow two hours to elapse at least before the bath is taken, but of course the length of time in any particular case will be determined by the nature and amount of the food taken.

Many valuable lives have been lost through ignorance or carelessness with respect to the above simple rule. The busy city worker leaves town for a few days' or a few hours' holiday at the seaside or in country. After his journey he is hungry, and on his arrival takes a meal, then rushes off for a plunge into the sea, or clear cold water of the river. He takes a few strokes if he is a swimmer, then a faintness and numbness steal over him, his strokes fail, and if he is out of reach of help, after one brief struggle he sinks. It is well known that many of the deaths by drowning, which occur every year round our coasts, and which are ascribed to cramp, are brought about in the manner described above.

Probably nothing is more enjoyable to the active, strong man, who is a swimmer, than the plunge into the cold sea, and the ride on, and struggle with, the waves. Frequently lives are lost, though, by the swimmers misjudging their strength. The city or professional man, who was a powerful swimmer when at school or college, but who has become more or less enfeebled, muscularly, by his sedentary and town life, plunges into the water, strikes out at first with his old vigor, an invigorating feeling steals through him, and on he goes, ignorant of his weakness and danger, until at last he turns to find the shore a long way off; he struggles now to return; slowly he approaches, his strokes growing weaker and weaker, until he presently feels and knows his weakness; he is faint and dizzy,

a numbness is stealing through his limbs, and he is fortunate if he manages to reach the shore, and crawl up on the sand weak or fainting; alas! often his strength does not hold out, and he becomes exhausted and sinks, to find a watery grave. Those swimmers, then, who do not get an opportunity of frequent practice, should be cautious the first time they renew their bath in the open cold water after a long abstinence from such exercise.

The following Rules for Bathers are issued by the Royal Humane Society:—

"Avoid bathing within two hours after a meal.

"Avoid bathing when exhausted by fatigue or from any other cause.

"Avoid bathing when the body is cooling after perspiration.

"Avoid bathing altogether in the open air, if, after having been a short time in the water, there is a sense of chilliness with numbness of the hands and feet; but bathe when the body is warm, provided no time is lost.

"Avoid chilling the body by sitting or standing *undressed* on the banks or in boats after having been in the water.

"The vigorous and strong may bathe early in the morning on an empty stomach.

"Avoid remaining too long in water; leave the water immediately there is the slightest feeling of chilliness.

"The young, and those who are weak, had better bathe two or three hours after a meal—the best time for such is two to three hours after breakfast.

"Those who are subject to attacks of giddiness or faintness, and those who suffer from palpitation and other sense of discomfort at the heart, should not bathe without first consulting their medical adviser."

A cold bath drives the blood from the skin, if the exposure is not too prolonged, this is followed by a reaction, the warm blood flows rapidly through the skin, and an agreeable sensation of warmth, "a warm glow," and increased vigor, are experienced.

If the stay in the cold water is too prolonged, the skin remains cold, shivering and faintness set in, the skin is blanched, the fingers and toes become white and benumbed, a feeling of sickness follows, and the person knows he has had "too much of it." The pleasant after-glow indicates that the bath has been beneficial, and unless it is experienced, then, in some degree, the cold plunge should not be indulged in.

A warm bath causes the blood to rush to the skin, so that on stepping out of the bath, much heat is lost from the surface of the body, and the excess of blood which was artificially called up to the skin by the warm water is driven back by the colder air, and we feel cold. Nevertheless, the warm bath is of use in many cases; for example, it may be employed with advantage to restore the action of the skin, after exposure to damp or cold. But when so employed, the warmth should be maintained by at once retiring to bed.

When the skin is delicate, and it is necessary to take great care of it, warm water should be used for washing, except, perhaps, in the hottest weather of summer. Those suffering under the eruption on the face, known as acne, should use hot water, even in summer. The cold morning bath and friction on the skin should not be indulged in by those whose skins are in a tender state; for, although the cold bath and friction are capital things in themselves, and keep the skin in a healthy state, yet when it is in a delicate or diseased condition, they irritate it, and so do harm. In such cases the vapour, or warm bath, or Turkish bath, may be substituted.

Sea bathing is most refreshing and valuable to those who are healthy; but those suffering from a delicate skin should avoid it, for in such cases the cold salt water irritates the skin, and aggravates the disease. There is no doubt, though, that bathing in salt water is more invigorating and refreshing to those with healthy skins than fresh water bathing.

Washing Water.—Soft or rain water is the best to wash in. Hard water makes the skin rough, and causes it to crack. The

saline matters present in hard water tend to curdle the soap, and retard the formation of a lather, converting it into a thick curdy compound, which will adhere to the skin, but will not cleanse it. Remember that hard water may be partially softened by boiling; for, on the application of heat, some of the excess of carbonic acid is liberated, and a portion of the saline matter is deposited as a crust on the sides of the kettle. Water which has been boiled then is better to use for washing purposes than ordinary hard water.

We cannot leave the subject of the skin without making a few remarks with respect to the hair.

The **hair** being a bad conductor of heat, tends to preserve the warmth of the body. Thus, in the case of the head, it serves to equalize the temperature, protecting the skull and brain from the heat of the sun, and preventing the rapid loss of heat by radiation. The eye-brows and eye-lids fulfil the special purpose of protecting the organ of sight, as well as adding to the beauty of the face. The hair at the openings of the nostrils and in the ear-holes acts as a medium of defence against external irritants, such as small insects, etc.

The **hair requires cleansing** as much as the skin, and where it is short it may be washed every day; in other cases it should be washed at least every eight or ten days. Careful washing prevents its decay, promotes its growth, and those who wish to preserve their hair will find that it is strengthened and its growth stimulated by frequent washing. It should be washed with good soap, not too strong or alkaline in its nature. During the washing much of the natural oil or sebum is removed; it is therefore desirable in some cases to rub on a *little* oil or pomade after it has become quite dry. Good and simple pomade may be made by well mixing equal parts of pure cold cream and vaseline. When strong soap or borax is used for washing the head, it most thoroughly and effectually cleanses it; but it also causes the hair to become dry and hard, because it removes the natural oil, and it may afterwards split or break.

The hair should be brushed with a soft brush; when a hard brush is used it injures the skin, or tears out the hair and breaks the skin, and clouds of scales or scurf may be liberated from the surface; but when so broken up, it re-forms faster than ever—in other words, the growth of scurf is promoted to a great extent by hard brushing. The teeth of all combs used should be rounded at the points and not sharp, for the sharp pointed teeth which are made to many combs tear the skin.

Frequent cutting causes the hair to grow thicker, and increase its strength. The long hair of young growing girls frequently splits at the ends; when such is the case, it should be carefully cut. It is generally benefited by cutting off three or four inches from the ends. Where such a course is not desirable, it is advisable to cut off the hair just above the point where it has split, and then anoint the cut ends with a little sweet oil.

Baldness.—It is a matter of common observation, that men are more often bald than women, and of men, those who spend most of their time in a shop or draughty office, and hence, those who wear their hats a great deal are most subject to it; it appears, therefore, that baldness is, in some way, connected with the question of head covering. Doubtless, the reason why women are less often bald than men is found in the fact that, as a rule, their heads are less closely covered. Some few years since, when it was the fashion for women to dress their hair over great pads, chignons, or similar artificial appendages, it was quite a common thing to hear the slaves to fashion consoling each other on the loss of hair, and they frequently bewailed their rapid loss, which, in many cases, to use their own words, "came off in handfuls." The cause was, no doubt, the over-heated and unhealthy state produced by overloading the head with the artificial pads, which prevented the proper nourishment, growth, and development of the hair. Happily for these afflicted ones, the style at the present time is more healthy and natural, and may the day be far distant when the chignon, as a torture, is revived. The hair of woman is one of the many points

of beauty with which nature has endowed her; yet, in many cases, it appears that she feels called upon by fashion to inflict pain upon herself, by means of the hair of her head.

Baldness, which is so prevalent amongst certain classes of men, especially shopkeepers, results, in many eases, from the continued use of a heavy, tight-fitting hat; in some cases, it may result from hereditary predisposition, or from disease or over-work.

The heavy hat generally worn by men in this country confines the perspiration, and the skin becomes over heated. The weight of the hat presses on the blood-vessels which supply the skin of the head and the hair with nourishment, so that the free circulation of the blood is obstructed. These combined eauses of over heating and reduced supply of nutriment result in the loss of the hair.

Hats and hair dresses generally should be light and airy and freely ventilated. All who can do so, should endeavour to do without a hat, except when out in the open air, and the one then worn should be well ventilated.

CHAPTER XXIX.

PARASITES.

What is a Parasite ?—Disease Germs.—True and False Parasites.—Dodder and Mistletoe, their Growth.—Trichina Spiralis.—American Pork—Exclusion from France.—Life History of Trichina.—Symptoms which attend its Growth.—Tape-Worms.—Common Round Worms.—Ring-Worm.—Itch.—How to avoid Parasites.

A **Parasite** we may define as a low form of vegetable or animal life which lives and grows upon or in the body of a living plant or animal, from which it derives its food. The name has been metaphorically applied to certain despieable members of the human family, whose object in life appears to be to cringe and fawn to others, living upon their smiles and bounty, but chiefly on the latter, willing to do any work no matter how merciless,

base, or cruel. It is such a character that Macaulay has described in the following lines :—

> "*Nor lacks he fit attendance, for close behind his heels,*
> *With outstretched chin and crouching pace the client Marcus steals ;*
> *His loins girt up to run with speed, be the errand what it may,*
> *And a smile flickering on his cheek for aught his lord may say.*"

The **common mistletoe**, a plant known to all English men and women, from the importance which it acquires at a certain festive season of the year, is a kind of parasite which lives and grows on the apple and oak. We have spoken of it as a kind of parasite, because it is **not a true parasite,** for it has thick green leaves, by means of which it takes some food from the air. A **true parasite,** on the other hand, lives wholly upon matter derived from the living things upon, or in which, it is found. As an example of such, we have the **common dodder,** which frequently proves so destructive to our crops. This parasite robs the plant upon which it grows of its hard-earned nutriment, and as the parasitic growth spreads, it gradually starves and kills the plant which has yielded it nourishment.

Many diseases of the human body are due to parasites; it therefore becomes necessary that we should learn something of their life and growth, and how to recognise those which most commonly affect the body.

Many **epidemic diseases** have been proved to be due to the growth in the blood, and fluids of the body, of low forms of life; and, probably, all epidemic diseases are produced in a similar way, although the individual organism which produces each has not yet been identified. The minute forms of life, which, by their growth in the body, produce these diseases, may be regarded as parasitic. Their germs, which are microscopic kinds of seeds, float about in the air, and may be introduced into the body with the food we eat, the water we drink, or the air we breathe, but they only grow and develop in the body under certain circumstances, that is—when the blood, fluids, and general conditions of the

organs, are favourable to their growth. Although, as before stated, the germs of zymotic diseases may be regarded as the seeds of minute parasites, yet, we shall not deal with them further in the present chapter, but only with the larger and better-known parasites, reserving the question of germs, and their growth, for future treatment.

Many of the **skin diseases** of man are caused by the growth of lowly organized plants; thus, for example—the *tinea*, or ring-worm, is caused by the growth of a low form of vegetable life termed *tricophyton*. These, and similar organisms, live, feed, and grow upon the surface of the body; others, such as tape-worms, and trichina spiralis, are found within the body. As the latter kind of parasites are by far the most dangerous to our health and life, we will deal with this class first.

The name of the **trichina spiralis** must be familiar to most of my readers. The newspapers frequently contain reports concerning cases of disease and death, ascribed to eating American pork, which is sometimes affected with this parasite. At the present time, the news that M. Paul Bert has obtained a vote against the admission of American pork into France, has caused no little excitement in the public mind.

It appears that the trichina was discovered by Sir James Paget, in 1834, and was first described and named by Owen, in the following year.

When a small thin piece of the flesh or muscle of the pig containing trichinæ is examined by the aid of the microscope, a number of small somewhat elliptical specks are seen, these are termed cysts. These small cysts, on further examination, are seen to contain something which looks like a fine coiled thread, this is the small worm.

The capsules or cysts vary from $\frac{1}{60}$ to $\frac{1}{70}$* of an inch in length, and are about $\frac{1}{300}$ of an inch in width. Seen with the naked eye, the cysts appear only as minute specks in the flesh; therefore, if

* Cobbold says they average $\frac{1}{75}$ inch in length, and $\frac{1}{300}$ in breadth.

the least speckiness is observed in the flesh of pork it will be well to submit it to further examination. If the trichinosis is well developed, the little cysts are very numerous, and the walls of many of them will be found strengthened, and made more conspicuous by a limy deposit.

The body of the female trichina is thicker than that of the male, and is mainly occupied by the egg producing apparatus which, compared with the size of the same organs in the higher animals, is out of all proportion with the rest of the body. This enormously developed reproductive system it is which accounts for the wonderful fertility of the parasite. It has been estimated that each female trichina may produce from ten to twelve thousand eggs. This is no exception, for as we descend the scale of life, we find that the reproductive powers of animals, generally, increase ; it appears that as the chances of development and maturity are decreased, so the power of producing offspring increases. In its encysted state, the trichina is inactive, immature, and is incapable of producing young, and it is in this condition that it exists in the flesh of the pig. If such a piece of infected flesh is swallowed by man, it passes into the alimentary canal. The conditions now become favourable for the further development of the trichinæ, and in less than two days after they have been swallowed, they become matured.

The reproductive organs become fully developed, and in about six days the female worms contain perfectly developed free embryos ; each mother-trichina, under such conditions, produces thousands of offspring, hence immense worm populations are soon produced.

The young worms do not remain in the intestine, but migrate—boring their way through the walls of the digestive canal, and through the various tissues of the body—until they find a resting place in the voluntary muscles. During the wandering of the hordes of young trichinæ, and whilst they are migrating from the digestive canal to the muscles, the fearful disease known as trichinosis is developed.

Trichinosis is generally attended by sickness, violent vomiting, and diarrhœa followed by fever, and severe muscular pains, which have been described as like so many millions of little moving splinters in the flesh. If the trichinæ are very numerous the muscular tissue become disintegrated, delirium ensues, and the patient dies in a state of extreme exhaustion. It is difficult in many cases for a time to distinguish the symptoms of trichinosis from those of acute poisoning; but in bad cases, on about the seventh or eighth day of the disease, its true character is indicated by dropsical swellings of the eye-lids and the root of the nose.

Where the constitution is strong, or the disease occurs in a milder form, the patients' strength may enable them to bear up during the migration of the parasites, until they have settled in the flesh. There is then little to fear; for having settled in the muscles, the young trichina becomes encased in a capsule or cyst. After having remained in the muscles in this state for some months, the encysted parasite gradually undergoes a change, becoming calcareous in its character, until presently minute specks of limy matter are all that remain of the trichinæ.

The result of experiments carried out in England and abroad have been to show that carnivorous animals, and those which subsist on a mixed diet, are especially subject to the attacks of this parasite; but it appears that whilst trichinæ may be reared in herbivorous animals, such are not subject to invasion by them. Trichinæ worms are chiefly found in the flesh of pigs, rats, mice, and cats. As regards the number of trichinæ that may exist within an animal, Dr. Thudiccum estimated that a man who died of trichinosis was inhabited by a population of 40 millions; and Dr. Cobbold thought 100 millions would have been nearer the truth, as in places the point of a needle could not be turned between the capsules, so closely were they aglomerated.

The encysted trichina is difficult to kill, and withstands the effects of smoking, salting, and curing, to which the flesh of the pig is subjected in the preparation of ham. Fortunately, though, the

disease is almost unknown in this country, except by report. But in Germany, and some other parts of the continent, where less care is taken in thoroughly cooking pork, and where large quantities of uncooked or undercooked smoked pork is eaten, this fearful disease is frequent.*

The lesson we learn, therefore, is that pork should be thoroughly cooked in order that these pests may be destroyed, if they exist, and the chances of disease reduced.

The **tape-worm** is another parasite, which is certainly better known in this country than the trichina. The invasion of the body by this organism is not attended generally with such serious consequences as that of the trichina spiralis. But it often gives rise to such disturbances in the body as are the foundation of ill health. It has received its name from its presenting the appearance of a band of ribbon or tape. A tape-worm consists essentially of three parts—first, there is what is called the **head**, which is always very small and out of all proportion with the rest of the organism; for, in a tape-worm measuring 15 feet, the head is often represented only by a point about as large as a pin's head. Next the head the body is divided by a number of small joints; this part is spoken of as the neck, and immediately succeeding it, we have the main body of the animal composed of larger joints. In the human body the head of the tape-worm remains firmly attached to the lining membrane of the digestive canal by means of a series of small hook-like appendages, which occur around its head. The animal continually grows by new joints, which are produced at the neck extremity—the oldest joints being those farthest away from the head. The animal continues to grow in this way, joint by joint,

* "Many instances of this terrible disease, isolated or in numbers, have now been recorded, and particularly in Germany. Of 103 healthy people, who ate diseased pork, which had been made into sausage-meat, at Helstadt, in Prussia, 20 died within a month. . . . In all the fatal cases the worm was found to have penetrated the whole muscular system, and upwards of 50,000 were computed to exist on a square inch."—Dr. Ed. Smith on Foods.

as long as it remains in contact with the walls of the alimentary canal.

The joints of the tape-worm contain egg sacs, in which the eggs are produced, and from which they are liberated. Each egg is capable of giving birth to a new tape-worm when it is placed under conditions favourable for development.

The **life history of the tape-worm** may be divided into two periods. The first of which is passed in the body of the animal in which the worm has been developed from the egg; but it is not brought to maturity in this, its first home. In the second, it becomes fully matured. The first home in the case of the common tape-worm (*tænia solium*) is the body of the pig, and the second may be, and frequently is, the digestive canal of man. If the eggs of this parasite are swallowed by the pig, they develop and give origin to young and imperfectly developed worms known as boring larva. Having entered on this stage of its existence, it bores its way to the flesh of the animal, where it becomes encysted, that is, the small worm becomes surrounded by a capsule or cyst. These encysted larvæ give the flesh a white speckled appearance, and pork so affected is spoken of as measly. Here, as far as the pig is concerned, the life history of the parasite ends; but if the undercooked flesh is taken as food by man, the second stage of the life history begins. When the food enters the stomach, and the muscle is broken up, the little cysts are dissolved, and the small and immature worm is liberated. The head now attaches itself to the lining membrane of the alimentary canal, it begins to grow rapidly, the joints appearing in quick succession until the worm becomes a fully developed and mature parasite, capable of producing eggs for the perpetuation of its species.

The life history of the tape-worm (*tænia mediocanellata*) which is found in beef, is similar to that described above, save that this parasite passes through one period or phase of its existence in the body of the ox or bullock, instead of the pig. It is present in the encysted state in the lean or flesh part of **measly beef.** When

introduced into the body of man in underdone beef, its development continues, and the perfect beef tape-worm is produced. This parasite often attains a length of thirty feet.

In a somewhat similar way we find that the encysted worm of the flesh of the mouse or rat becomes the mature worm, inhabiting the digestive canal of the cat. The encysted worm found in the rabbit's liver becomes fully developed in the alimentary canal of the dog.

In the cases above described under the head of tape-worms, those affecting man visited him as their second home, their development from an egg taking place, and the first part of their existence being passed in the body of some other animal, in which they developed as far, and existed only, as encysted larvæ.

We have next to deal with a tape-worm which is developed from an egg, and passes through the first stages of its life history in the body of man. That is, in this case, the body of man is the *first* home and not the *second.* This worm, *tænia echinococcus*, inhabits the digestive canal of the dog, where it lives, grows, and produces eggs, just in the same way as the *tænia solium* finds a home in the alimentary canal of man. The eggs are cast off in great numbers from the digestive canals of dogs, in which the worms live. If these eggs are swallowed by man—and they adhere to and are frequently swallowed with vegetable foods—they develop and pass, not to the flesh or muscle, but to the liver, where they give rise to the disease of the liver, known as *hydatids.* In the liver, the growth of the eggs by budding is set up, and in this way they increase rapidly, one egg dividing into two, two developing into four, and so on. By this means a simple egg may grow into a mass, and the liver becomes covered with small tumour-like excrescences, and frequently death results.

The eggs of tænia echinococcus may be introduced into the body on the surface of imperfectly washed vegetables; celery, lettuce, and similar plants, which are grown in large quantities of manure, may be the means by which these unwelcome guests

are carried into the body. It is worthy of note, that in Iceland, where the number of dogs kept is greater, and the relationship between the dog and his master is much closer, than in this country, "hydatids" is very prevalent.

The broad-headed tape-worm (*bothriocephalus latus*) is prevalent amongst those people who live largely on fish. It attains a great size, being frequently from $\frac{3}{4}$ to 1 inch in breadth, and 20 feet in length. In North Russia, Sweden, and Ireland, it is fairly well known. The first homes in which the early stages of the life history of this parasite are passed are probably the bodies of fish.

Tape-worms may find their way into our bodies with underdone meat, or by way of salad, cucumbers, celery, or other vegetables which are eaten raw. The chances against their introduction into the body in a living and necessarily harmful stage, may be immensely increased by thoroughly cooking all meat consumed as food, and by thoroughly cleansing all vegetables before they are eaten.

The **liver fluke** (*fasciola hepatica*) inhabits the liver of the sheep, where it gives rise to "liver rot." It is a somewhat flattish oval organism, about half an inch in length when mature. This parasite passes the first stage of its existence in water, and doubtless finds its way into the body of the sheep in the impure water which it takes as food. There are cases on record in which this organism, or one very closely allied to it, has been found burrowing in the skin of man.

Common round worms.—*Oxyuris* is a small worm, which is found frequently in the alimentary canals of children. Its life history is comparatively simple. In this case there appears to be no question of first and second home, but the worm is produced directly from eggs cast off from the digestive canal of one previously afflicted by the parasite. *Ascaris* is also commonly found in the human body; its life history is as simple as that of oxyuris, and infection appears to be in the same way—direct.

Ring-worm and most other skin diseases are due to the growth of low parasitic forms of life. *Tinea* or common ring-worm is due to the growth of a lowly organized form of vegetable life. *Favus* or scald-head, which is indicated by the presence of sore places on the scalp, is due to the growth of a fungus termed *achorion*. *Herpes*, in a similar way, is due to the growth of a fungus.

Scabis or "itch" is due to the growth in the skin of a small parasite, the female of which burrows and tunnels into the skin, lays its eggs, and rears a family of thousands of offspring in a short time. During their growth the most distracting irritation of the skin is produced. This disease may easily be transmitted from the diseased to the healthy; the act of shaking hands being sufficient alone to produce infection.

A mite, about $\frac{1}{80}$ of an inch in length, is very frequently found inhabiting the small follicles of the skin at the sides of the nose. It is known as *demodex folliculorum*. So comparatively harmless is this little parasite, that, although it has been estimated that it is present in the skin of the parts mentioned in every two out of six or seven persons, yet in most cases its very existence is unknown.

The growth of acrux scabici and demodex are promoted by the presence of dirt; therefore, we have another reason for paying very great attention to the thorough cleanliness of the skin.

How to avoid parasites. *Firstly—Never eat underdone meat*, and see that pork, especially, is thoroughly cooked; for, by taking imperfectly cooked or raw pork, beef, or fish, we may introduce into the system different forms of parasites, in various stages of development. It is well to remember, that meat is changed in colour, from red to brown, at a temperature of 150 degrees Fahrenheit, also that the vitality of most eggs, or encysted worms, is destroyed when heated to this degree.

Secondly—All vegetables should be thoroughly washed, special care being paid to those which are eaten raw: celery, lettuce, and water-cress, require great attention. Nuts and fruits which have

been picked from the ground should be cleaned, and the peel of the fruit carefully removed. Children should be warned against cracking the nuts with their teeth, not alone because they may injure the teeth, but also because the shell may be the means of introducing these parasites into the mouth, and so into the body.

Thirdly—Be scrupulously careful of the cleanliness of the skin, clothing, and all vessels and other utensils connected with the preparation of food.

Fourthly—The seeds or germs of the fungi, which produce many skin diseases, such as "ring-worm," "scald head," "barber's itch," may be conveyed from the diseased to the healthy by change of hats, bonnets, gloves, combs, brushes, and by using the same towel, or even by touching the same object.

Fifthly—Children frequently catch ring-worm, and other skin diseases, by playing with dogs, cats, kittens, and puppies, in the skin of which animals, the fungi causing these diseases are quite common. The infected dog or cat may be known generally by bald spots which occur on the skin, for the growth of the fungi results in the destruction of the hair.

CHAPTER XXX.

CLOTHING.

Objects of Clothing.—Materials for Clothes.—Wool, Silk, Cotton, Linen, etc.—Underclothing.—Colour of Clothes.—Corsets.—Tight Clothes.—Injurious Effects of Tight Clothes.—Poisonous Dyes in Clothing.

THE chief **object of clothing** is to protect the body from external influences. It necessarily follows, then, that the kind and amount of clothing will vary with these external influences. In cold and variable climates, clothes serve to retain the heat which is produced within the body, thus preventing rapid loss and cooling by radiation and evaporation. In a climate such as ours, then, through the greater part of the year, clothes serve to keep in the heat of the body.

In hot countries the body must be protected from the excessive heat of the sun; clothes, in such cases, serve as shields. We see, then, that on the one hand the main object of clothing is to keep in the heat, and on the other to keep off the excessive heat. A further object with some, and one not altogether unknown among savage nations, is that of wearing clothes for display—to make the individual look conspicuous or to attract attention.

The natural heat of the body is lost when the surface is exposed to cold air, in three ways :—

1. *By direct radiation of heat from the exposed surface.*
2. *By the evaporation of moisture.*
3. *By direct conduction—that is, the giving up of heat to the particles in contact with the body.*

The **material** of which clothes are made should be as **light in weight** as is consistent with proper protection. Those substances form the warmest clothing materials which are the worst conductors and radiators of heat; for example, a thin white linen coat is a better conductor and radiator than a thick fur coat.

Loose clothing which admits of the free play of the muscles, and transpiration from the skin, is warmer than tight clothing. It is within the experience of many, that tight-fitting gloves make the hands exceedingly cold, by impeding the circulation. Loose ones keep them warm, because they prevent rapid radiation of heat. They do not interfere with the free circulation, and there exists between them and the hand a thin layer of air, which is in itself a bad conductor of heat, and hence will not facilitate the passage of heat from the warm hand to the glove.

Many may also know from experience, that two comparatively thin and loose pairs of socks keep the feet warmer than a single tightly-fitting pair, which may even be thicker than the two thin ones together. In the same way, easy shoes or boots are warmer than those which fit to the foot tightly. Although warmer in winter, for the same reason, loose clothing is cooler in summer. When compared with what is stated above, this looks uncommonly

like a paradox. But let us examine the question further. We said that loose-fitting garments would not allow of the rapid passage of heat from the surface of the body; for the same reason, they will not quickly absorb the sun's heat and conduct it to the body. At the same time they admit of perfect ventilation, and do not so readily become moist with perspiration. Loosely made clothes are, then, healthiest and best for all seasons and all classes. They should be made always, neither to compress and fit tightly on the body, nor to hang very loosely and look untidy.

The materials used for clothing vary very much in conductive and radiating powers; consequently, some are much better adapted for retaining the heat of the body than others. The common materials used for clothing rank in value as protectors; thus, silk, wool, cotton, linen.

Wool is one of the worst radiators, and so one of the best substances for keeping in the warmth of the body.

Clothing made of wool will absorb a far larger amount of perspiration, with less danger of the wearer taking cold from its moist contact with the skin, than any other of the ordinary materials employed. Light flannel, therefore, is good as underclothing for almost all seasons of the year, except perhaps the hottest part of summer. Flannel or a blanket will keep us warm. Why? Because it will not allow the natural heat of the body rapidly to escape. On the other hand, a blanket keeps ice cold. Why? Because it prevents the passage of external heat to the block of ice. Its bad conducting and radiating powers interfere with the escape of heat from the body, and its bad absorbing and conducting properties prevent heat from passing to the ice.

Silk ranks even before wool as a clothing material, although not so largely used. It is lighter, smoother, softer, and absorbs less water than wool, and serves as a most excellent protection for the body. For those who can afford them, silk underclothes are to be preferred before flannel, for they possess all the advantages, and none of the disadvantages, of that material; moreover, they are, in

the long run, not much dearer than those made of wool; for although, in the first plaec, silk eosts more than flannel, yet good silk will last for a very much greater length of time. Pure silk fabries are exceedingly strong and lasting, for silk threads are twice as strong as those of hemp of the same thiekness, and three times stronger than corresponding ones made of flax. A material is now in the market which consists of a mixture of wool and silk, which is soft, and recommended for those who find ordinary flannel heating and irritating to the skin.

Velvet is prepared from silk by inserting short silk threads under the cross threads, so as to form a "pile." *Crape* is manufaetured from raw silk, the inferior varieties being composed of a mixture of cotton and silk. Silk manufactured with a soft, polished, and smooth surface, is known as *satin*.

Linen is prepared from flax, and is the smoothest and coolest of all materials used for clothing. It is exceedingly useful as an article of underclothing, although it eannot be compared for warmth and comfort with wool and cotton. One of the disadvantages which attend its use is, that it retains the perspiration, and prevents, to a certain extent, the healthy aetion of the skin, unless very frequently changed. *Cambric* and *lawn* are fine, thin varieties of linen materials.

Cotton, as far as its value as a clothing material is eoncerned, stands intermediately between wool and linen; it is warmer than linen, and allows of the free and healthy action of the skin. *Calico*, *muslin*, and *fustian* are manufactured from cotton.

Colour of clothes.—The amount of heat absorbed by a body varies with its eolour. If equally thick, it has been proved, that all dark substances will absorb more heat, and hence are warmest when the external heat is great. Many of my readers must have experienced that, on a hot summer's day, a black coat or dress becomes almost unbearable.

Not only are **dark elothes** good absorbers of heat, but they are, comparatively, *good radiators*; therefore, when in winter the

internal heat is greater than the external, or sun's heat, they tend rather to facilitate the loss of bodily heat. Some may argue, how is it that they feel warmer? how is it again that their use has become so general? In the first case, because it has become the practice for manufacturers to make up the dark winter goods heavier than the lighter-coloured summer materials, therefore, the comparisons, as generally made, are unfair, because the weight of material is not the same; in the second place, dark clothes are doubtless more economical in such a changeable climate as ours.

Light-coloured articles of dress reflect more of the sun's rays, and are therefore cooler in summer than dark ones—even when the thickness is the same. As a matter of fact, then, light clothes, were they generally made as heavy, would be warmer for winter's wear than dark ones. To re-state the facts, in other words, dark articles are generally good absorbers and good radiators. Therefore, in summer, the external heat being excessive, and such materials being good absorbers, they would, by taking in heat, tend to make the body hot. In winter, on the other hand, the internal or bodily heat being greater than the external heat, they would, by radiation, tend to lower the temperature of the body.

Think for a moment of the wise provision of Nature in this respect: the animals of cold regions are provided, not with black coats, but with thick white coats of fur, to protect their bodies against the rigour of the climate. Of course there are other factors to take into account in explaining this peculiarity on the part of the animals inhabiting excessively cold regions, such as the correspondence between the hue of the animal and that of the surrounding objects, whereby the animal is not rendered conspicuous, and hence is less likely to become the victim of others. In other words, all other conditions being the same, those animals are least likely to fall a prey to others, which, by the nature of their coats, cannot well be identified from the bodies—white generally—by which they are surrounded, and hence such would most likely survive and produce offspring, in which this peculiarity would be reproduced.

But one of the enemies which are likely to cut short the lives of these animals is the cold and rigor of the climate; it appears, therefore, that those are best able to withstand it which are provided with white coats.

For all seasons of the year in this country, for those who cannot afford a number of changes of dress, without doubt, grey is the best tint. Such will be found most conducive to health and economy.

Underclothing worn next the skin should be made of silk or some woollen material. This is most essential for young children and old people, for at these periods of life the heat-producing and cold-resisting powers of the body are feeble. In the case of those at the more vigorous periods of manhood and womanhood, perhaps the necessity for woollen clothing is not so great. Loosely knitted undervests made of wool are the best in winter; these, in summer, may be laid aside, for lighter-made woollen undershirts. All underclothing worn during the day should always be removed when we retire to rest. It may not be out of place to remark here that there is no special advantage in coloured flannel for underclothing, but there are disadvantages attending its use. It does not show the dirt, and hence may tempt some to wear it longer than is good for health, and the colouring matters may contain injurious substances. Eruptions of the skin are frequently caused by the materials with which some woollen goods are brightly dyed. Remember, that one of the good characters of flannel is, that it readily absorbs perspiration, consequently it soon becomes charged with this matter, and with particles worn off from the skin; thus it becomes dirty and unwholesome to the wearer, and may become unpleasant to those around him. Flannel underclothing should be frequently changed, such change to be made at least once a week. In the case of those who perspire freely, or those who are engaged in active muscular work, a change twice a week is recommended.

The **articles of clothing placed next the underclothing** vary in the two sexes, and the only remarks that it is most necessary to

make about them is, that they should be as light as is compatible with protection and warmth. They should be clean, and should fit the body without oppressing it; no part should be over-loaded with clothes to the exclusion of others. The multitudinous strings and tapes by which the garments of women are tied at the waist, tend to oppress the abdominal organs, and prevent their healthy action. The **belt** worn by many men is equally harmful; both alike impede the breathing; and owing to the pressure which they exert upon the walls of the abdomen, they prevent the free action of the abdominal organs, retard the circulation, and increase the liability to rupture. As far as support and strength being derived from them is concerned, it has been conclusively proved that they really weaken the body. They reduce the amount of work, which devolves upon the muscles in the first place, and the muscles being thus unemployed, become degenerated and less able to do their natural work when called upon. That which, therefore, in the first case was an artificial and unnecessary support, becomes in time almost a necessity, as the result of artificially induced weakness.

Corsets.—So much has frequently been said and written on the subject of corsets with so very little effect, that it seems almost a hopeless task to continue the battle against the use of these cruel instruments. Modern education is doing its work very gradually in this respect; but women have yet to learn how wonderfully they are made, and how beautifully the various parts of their bodies are constructed; how they are adapted to perform certain work under certain conditions; and how the organs, even struggle and struggle on, in spite of the almost over-powering obstacles that are placed in the way of their healthy work, in the form of tight corsets, powdered skins, tight boots, etc.

The ribs which bound the thorax or chest, and so protect the lungs and heart, are comparatively soft and elastic in youth, and it is only in the later stages of life that they become ossified and converted into true bone. **Stays,** then, for young growing girls **are especially harmful,** they press on the yielding ribs; compressing

them and reducing their growth, they prevent the free, healthy, and natural expansion of the lungs; they embarrass the action of the heart; and by pressing upon the walls of the abdomen, they restrict the work of the liver and other organs. By the false support they give, the muscles of the chest, spine, and back are deprived of their proper exercise; these consequently become attenuated, enfeebled,

FIG. 27.—THE NATURAL FIGURE.

and incapable of giving due support, hence the chest and spine frequently become deformed. In the case of a young girl, nothing should be done to support the spine by corsets. Where a young girl's back begins to curve, there is some weakness in the general health or error in the mode of sitting, etc. Good food, proper exercise, and care for position when at work, are in most cases the proper and most effectual remedies for such evils.

Where actual curvature, or stooping exists, and support is really necessary, then a special instrument should be employed, but stays should not be resorted to in any case. The muscles of a girl require exercise, and are capable of development just as much as those of a boy; her clothes, therefore, should be loose fitting and

warm, allowing free and unrestricted play to the muscles of the chest, back, and arms. No doubt, the reason one sees so many more women than men with twisted and deformed spines is to be found in the fact, that, through the cramping and artificial support to which those muscles have been subjected, whose natural work it is to support the spine, they have become cramped, wasted, and incapable of fulfilling their natural function. Give our girls play-grounds, and halls for gymnastics; let them throw aside the cruel unyielding stays; give them a fair chance, and they will be as straight and upright as boys usually are, and will lose nothing in

FIG. 28.—TIGHT-LACING ILLUSTRATED.

beauty, but will learn rather to perfect their grace of movement, by a better development and control of their muscles.

We learnt how **tight-lacing** may reduce the size of the chest, hinder the action of the lungs and heart, and the digestive organs. No doubt, there are some few unthinking ones, who, not knowing exactly what all this about reducing the action of the organs means, may say, "it don't harm any one else, and I am allowed to do as I like." Now, all will admit that those women who are most healthy, are likely to become the mothers of the most active and

healthy children. The healthy action of the organs is reduced by tight lacing; the blood is improperly aërated; the general functions of the different organs are not so well performed; therefore, for this reason alone, we have a right to raise our voices against the custom. Nor is this all, the practices which the belles of our London season pity or ridicule in their savage sisters, of splitting or perforating the nose, boring the ears and lips, and inserting blocks of wood, metal, or stone; of filing the teeth, or drilling holes through them, and inserting metal; and many other practices; are far less cruel and selfish than that of tight-lacing. The ignorant savage,

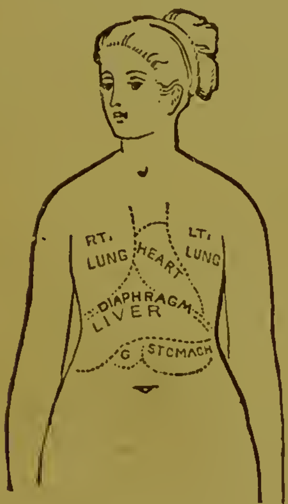


FIG. 29.—NATURAL WAIST.

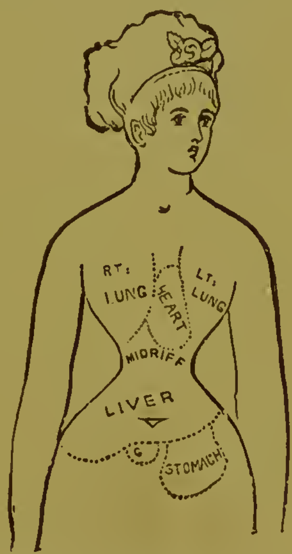


FIG. 30.—ARTIFICIAL WAIST.

standing with a flake of stone, and cutting the cartilage of the nose, is merciful when compared with the fine lady who stands before the glass tightening the string of her stays, and inflicting pain upon herself, and carefully planting the seeds of untold suffering for a generation yet unborn. The savage, to be in the "fashion," or to comply with conventional ideas of beauty, generally, inflicts pain only individually, and does not necessarily plant the seeds of deformity to be reproduced.

To explain further, not only does the corset tend to compress the organs in the thorax, but it tends to force the organs of the upper part of the abdomen downwards, so that they exert pressure upon the important organs in the lower parts of the abdomen. By displacement and pressure the size and natural development of these organs is retarded or reduced; hence, we have another reason for raising our voices on behalf of children yet unborn, in the strongest protest against the practice of tight-lacing.

Here, then, is a sphere for work at home, to teach this **fragment** only of the **gospel of health**, for the exercise of the energies of those ladies who have the welfare of our race, in fact of the human family, at heart. It is really a woman's work, and one in which the nobler and better informed of the sex would find ample scope and an unlimited field of action amongst their less favoured sisters who, through ignorance or carelessness, become the unintentional authors of pain and suffering.

The reduction of the capacity of the chest by tight-lacing, and the consequent decrease in the amount of air taken into the lungs, at once explains some of the common complaints of women—"*Don't walk so fast, I can't get my breath;*" "*I cannot walk up-stairs or up-hill without feeling short of breath;*" "*I had to stop on the stairs to get my breath.*" We may reply, yes, and so this shortness of breath will characterise your movements so long as the **crippling support** is not abandoned. The continual complaints made by women of severe pains in the back, and distressing pains in the left side, are, in a similar way, the effects of tight-lacing.

To impress the above facts, we will so far recapitulate what is stated above, as to summarise the effects which are immediately produced by tight-lacing; what the ultimate effects may be, the thousands who suffer under the cruel tyranny of the corset alone can say.

1. *The action of the diaphragm is interfered with*, and, hence, respiration and the purification of the blood is impeded.

2. *The circulation of the blood is obstructed*, and so we get the

characteristic pale or bluish-red skin—both alike the result of sluggish circulation.

3. *The muscles of the back and trunk generally, being tightly encased and surrounded, lack exercise, and so tend to waste and become weak.*

4. *The organs of the abdomen become compressed and displaced,* therefore healthy development and action cannot take place.

5. *The shape of the body is altered,* that which by nature is beautiful, becomes distorted, and is rendered hideous.

Does tight-lacing make the human figure more graceful or beautiful? It has been said by some irreverent and cynical one, that a woman without her stays would look like a bag of sawdust with a head upon it, and this is followed by the assertion that the corset imparts beauty to the human figure.

Perhaps the shape of those who, for the greater part of their lives have worn stays and then abandoned them, is not altogether graceful; but this is only an argument against their use. The young girl at school, taught early to properly use her muscles, develops into the most graceful of women, whose movements are poetry, and she knows not the use or abuse of the corset.

There are very few who will call the block, which is exposed in a dressmaker's window, as a perfect ideal outline of what the female figure should be, more beautiful than the graceful curves and general beauty of form of a good copy of the Venus of Milo. Go and compare them: in one you find the wasp-like waist, which shows you what the **conventional idea of a beautiful figure** is; in the other, the magnificent outline, chiselled after the naturally beautiful body.

In cases of extreme weakness, if some sort of support becomes absolutely necessary, let it be as soft and pliant as possible.

All tight-fitting articles of dress are bad; they prevent the free circulation of the blood, and the healthy action of the skin. *Garters* in all cases are bad, as they press on the veins of the leg and interfere with the flow of blood to the heart, and so may produce

enlarged or *varicose veins;* they are frequently the cause of cold feet, because they impede the circulation.

Tight, heavy hats, by pressure on the blood-vessels, reduce the blood supply of the skin of the head, and hence may be the cause of baldness.

The *pressure of shoes, tight collars, sleeves, or clothes in general* is bad; for the blood supply is interfered with—the part becomes cold—imperfect nutrition is the result. A reduction in the amount of nutriment supplied to any organ is followed by imperfect growth and development, and this predisposes the part to the attacks of disease. Pressure of clothes, too, may result in actual deformity, as in the case of the feet. The tightly-fitting pointed-toed boots and shoes, which are the "fashion" at the present day, are the cause of endless deformities.

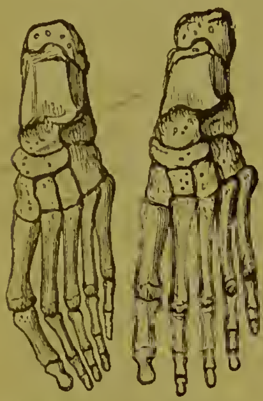


FIG. 31. DEFORMED FOOT. FIG. 32. NATURAL FOOT.

For **children and old people** the best kind of good warm clothes is a matter of extreme importance. The erroneous notion that is still held in many cases of a possibility of "**hardening children**" by exposure, cannot be too soon abandoned; existing, unfortunately, in the minds of many parents and relatives with otherwise the best intentions and the greatest love for their children, it causes them to become merciless and cruel. Their errors and cruelty are frequently attended with fatal results. We cannot do better than recall the saying of John Hunter, that, for rearing healthy, strong children, there must be plenty of sleep, plenty of milk, and *plenty of flannel.* The practice of **exposing the chest, arms, and legs of infants,** with the false idea of hardening in view, is bad. These parts should be warmly, yet lightly clothed, in order that circulation and nutrition may not be checked, and that the muscles may have free play. Another great fault is that the clothes of some parts are generally too heavy, whilst other parts are left bare, or are only very imperfectly clad.

Young children should be always warmly clothed; but as they grow and become more active, the power of resisting cold increases, and there may be less need for such great care. The sleeves of dresses for infants should be long, and the frocks should be made with high necks, but should not be made of heavy material. For children, long flannel night dresses are the best, at all seasons; they retain the heat of the body and keep the limbs warm, even if the child becomes restless, as is often the case, and throws off the bed-clothes.

Old people should also be warmly clothed, for the power of resisting cold is considerably reduced with age. Warm flannel garments should be worn next the skin, day and night. At this period of life the lungs and skin become less active, and are more susceptible to a sudden chill, the effects of which are, in most cases, far more serious after the age of sixty-five than in the earlier periods of life. All old people should, in every possible way, avoid loss of bodily heat, for cold is their great enemy.

The other articles of clothing should be warm, but not weighty, or they become wearisome. Flannel waistcoats and woollen goods generally are to be recommended. The two most important facts to remember are these:—firstly, at this period of life, the power of resisting cold is less; secondly, the aged man is less able to "throw off a cold"—that is, the unsettled state which is produced in the working of the organs of the body, is generally attended with more serious results.

It is important that the air and bed-room in which old people sleep be made warm in cold weather, in order that proper rest may be enjoyed, and the chances of cold reduced.

Individual peculiarities vary so much, that it is difficult to make rigid rules in such matters; but we may say, generally, that the **clothing of a healthy adult**, in the middle stages of life, should not be too warm; but in cases of predisposition to bronchitis or rheumatics, great attention should be given to warm under-clothing.

Night clothing.—The same article of under-clothing should

never be worn during the night as well as in the day. For adults, cotton or linen is the best material for night dresses; but for young children and old people, flannel, as before mentioned, surpasses all others.

Poisonous dyes used in the manufacture of clothing material. —Great advances have been made recently in the matter of dyes. Only a few years since, many substances were largely employed as colouring matters which were harmful, some being really strong poisons. Although much less common, still, clothes coloured with poisonous dyes do find their way into the market; for instance, the bright yellow and red colours of many fabrics is sometimes due to the presence of *chromates of lead.* Such substances when present in clothing materials may prove exceedingly injurious.

Cochineal red—a substance largely employed in dyeing—sometimes contains an injurious quantity of arsenic compounds. These, when present, may act upon the skin, producing, in the first case, simple irritation or even skin diseases, which are followed by more serious symptoms affecting the body as a whole.

The **bright green,** known as *Scheeles' green,* is a compound of arsenic and copper, which is occasionally employed to impart a green colour to clothing materials. We have found traces frequently, and sometimes even comparatively large quantities of this substance, present in chintz and cretonne.

Magenta, and a colouring matter known as coralline, which are used for dyeing, have been known to produce great irritation of the skin, and even skin diseases.

No coloured material should be worn next the skin; firstly, because many of the matters employed in colouring such, are harmful; and secondly, coloured materials do not show the dirt, and hence may cause some to wear them longer than is good for health. Red and carmine coloured socks are generally unhealthy; the perspiration moistens the sock, and aids in the removal of some of the dye, which adheres to the skin of the feet, and frequently produces inflammation, followed by a rash.

Coloured silk gloves, often worn by ladies, are bad; the colouring matters frequently produce blotches on the skin of the hand. All thin coloured gloves, and those for winter wear lined with red or magenta wool, should be avoided. Those with delicate and sensitive skins should not wear brightly-dyed gloves, stockings, or any other coloured articles of clothing, next the skin. In all cases, those materials which are coloured bright red or blue should be especially regarded with suspicion.

CHAPTER XXXI.

LOCAL CONDITIONS.

The Elevation of the Site.—How to Select a Site.—Hill, Plain, and Valley.—Wind.—Soil and its Drainage.—Consumption and Ground Water.—Aspect in Reference to Light and Wind.—Influence of Surroundings.

SELECTION **of a site for a house.**—A very large majority of persons are prevented by many circumstances from exercising a free choice in the selection of a habitation. There are many obstacles in the way of those who wish to choose the healthiest place of abode; for example, limited means, the kind of occupation, and family ties being, perhaps, the most important. The fact, too, that the worker wishes to find a home near his place of occupation, embarrasses him in the selection of a desirable place of abode. For many reasons, then, it is not always possible to choose the house, not even sometimes the locality, in which one would best like to live; but a house as far as possible dry, airy, and well lighted, should be selected. But granting that all conditions are favourable, and that a man really wishes to select a suitable spot for a habitation, then the first question that suggests itself is—"what is a desirable site?"

1. **The elevation of the site.**—The soil should be naturally dry and free of drainage; therefore, the selected spot should be more or less elevated, for all other conditions being the same, the higher the situation the drier will it be.

Valleys and depressions should therefore be carefully avoided; for they are generally damp, because the rocks and soil contain more or less stagnant water, which makes such situation unhealthy. If the neighbourhood is generally level, or partakes of the nature of a **plain**, then advantage should be taken of any slight swelling or elevation of the ground, in order that the house may be built as high as possible. If, on the other hand, the district is **hilly**, a spur or offshoot from the hill, is better than the sloping sides of the hill itself. Houses built directly on the slope are generally damp and unhealthy; they frequently suffer damage, too, from the matters removed from the high ground, such as rocks dislodged by rain, landslips, etc. The foundations of houses so situated are frequently damaged by the slow movement of inclined beds of rock. In towns which are built on the sides of a hill, very considerable variations of climate may exist; for instance, the air is generally drier and more bracing and invigorating on the hill-top, that is, in the higher parts of the town; whilst houses built on the slope are partially protected from the wind.

The **soil** or ground which is selected as a site should be naturally free of drainage. The power that rocks possess of retaining water varies a great deal, some—like sandstone and gravel—allow the water to pass freely through them; whilst others—such as those which are of a clayey nature—retain the water. In consequence of this impervious character of clay, it is largely used for lining canals, ponds, and artificial lakes. The amount of water held by a soil, and hence its value for building purposes, is not determined by the character of the surface layer alone; but it depends also upon the nature of the **subsoil**, or the rock upon which the immediate surface soil rests. For example: a thin sand or gravel, resting on a clayey subsoil, is generally unhealthy; on the other hand, although clayey ground is not usually to be recommended, yet where a thin layer of clay rests upon sand or a sandy rock, it may be perfectly safe.

Peaty soils and the alluvial soils formed from the mud brought

down by rivers—both of which consequently contain much organic matter mixed with clay—are bad. Such soils hold a large quantity of water, hence they are usually damp; and the decomposing organic matter which they contain, liberates unwholesome gases, rendering them very unhealthy. The object in view is to select a plot which will be as dry as possible; therefore, the best sites are those situated on sandstones, gravels, or limestones. Clayey rocks may form eligible sites, after they have been thoroughly drained; but in such, the drains may get out of order, therefore, those which are naturally drained and made dry, must be the best.

The above remarks apply mainly to **country or suburban districts. In towns** we have much less choice; but there is one class of soils characteristic of our modern cities, which should be most carefully avoided, and those are such as are made from rubbish. The method usually adopted in preparing such "**made soils**" is to select a hollow or low-lying piece of ground, then to expose the notice "rubbish may be shot here;" daily, waggon loads of miscellaneous rubbish—the contents of dust-bins, road stuff, and such like—are shot into the vacant space. Shortly the level is raised; the ground is made, and the builder begins to put up the shells, of what sooner or later may become fever dens. The rubbish composing such soils contains usually a large quantity of organic matter, which decays, and gives rise to injurious matters. Where it becomes absolutely necessary in the case of towns to "*make ground*," it should be exposed for a lengthened period to the purifying action of the sun's heat, rain, and frost, before it is built upon.

Subsoil and Drainage.—It has been observed that the health of a district is very largely influenced by the nature of the subsoil and its drainage; clay subsoils being unhealthy, especially in cases of consumption. Now, it has been previously explained that rocks and soils vary in porosity, that is, some allow water to pass freely through them, whilst others retain much water. Those rocks which are more or less impervious, like clay, hold a large quantity of what is termed *ground water*.

In most cases, if we dig deep enough, we find water collected in the rocks; but, in some places, we come upon it sooner than in others. It will be found that the height of the ground water varies with the nature of the rock of the district. In clayey districts it may be found two or three feet only beneath the surface; whilst in the neighbourhood of gravelly or sandstone rocks, it may be found at a depth of eighteen or twenty feet.

Other conditions besides the mere nature of the rock determine the depth at which the ground water is found; for instance, the slope of the beds of rock, the amount of rainfall, and the height of the particular spot, influence its presence. It must be obvious, that if the ground water is found near the surface, it will make the district damp and unhealthy. Experience has taught us that it ought not to be nearer the surface than four feet. In places where the ground water has been nearer the surface than this, it has been shown that a thorough system of drainage, by which its level has been lowered, has been followed by a decrease in the death-rate, and a generally improved state of the health of the inhabitants. Dr. Buchanan has shown that consumption has been diminished one half in Salisbury in consequence of lowering the ground water level. The accumulation of ground water may be prevented, by a thorough system of surface drains to carry off the ordinary rain and surface water, and by good subsoil drainage, in order to dry the soil. In places where there is fear of harm from the ground water, the conditions may be improved by laying a good concrete foundation.

Aspect in reference to light and wind.—The house should be so situated that the sun has free access to it; for although careless exposure of the body to excessive sunlight may be attended with bad results, yet ordinarily the action of light is most health-giving, and is almost as essential to the well-being of the body as fresh air. In this country, where the number of hot sunny days in the year is not large, and fear of excessive heat is not great, it is a good rule for the house to be built so that all its parts are exposed to the sun in the course of the day. Of course the rooms of the house, to be

used for different purposes, may be selected according to the amount of light required. The working room, library or study, where a steady diffused light is required, should face towards the north. The breakfast room, which should be bright and cheerful, may face the south, and so catch the cheering rays of the morning sun. The larder and store-room, which require to be kept cool, should face the north or north-west.

As a rule that house is the healthiest which is lightest and most airy. It is necessary that the house should be so situated that there is a free circulation of air about it; but whilst this object is kept in view, it is advisable in this climate to select some spot where shelter from the prevailing cold winds is afforded. Trees give all the shelter necessary in most cases by breaking the force of the wind, and at the same time they allow a free circulation of air about the house. In towns those houses are healthiest—all other conditions being the same—which are built in wide, open roads or squares, which permit of a free circulation of air. Narrow avenues, courts, and terraces should be avoided. The area flats of houses are usually unhealthy; they are generally darker than is wholesome, and we have seldom too much sun for the greater part of the year at any time, or even in any aspect; but besides being dark, they are frequently damp and ill ventilated.

Influence of Surroundings.—In dealing with the wholesomeness of houses it is necessary to see whether the drainage of a neighbouring house or houses is likely to find its way into the soil or subsoil on which we are situated. In most cases where two houses are situated close together, but at different levels, that built at the lower level is likely to suffer from the effects of the drainage from the one above. If the house stands some distance from human habitations, then it is still necessary in all cases to see that no decomposing organic matter, from which unwholesome gases may be liberated, is allowed to accumulate near it. Therefore, no heaps of farmyard manure, dust-bins, cess-pools, or any other collections of decaying refuse materials, should be allowed to remain in the

vicinity of the house. The house should not be built on the bank of a stream which receives sewage, nor should it be placed near a pond, marsh, or any place into which sewage is emptied. It is generally advisable that houses should be as far removed from manufactories as possible. Such neighbourhoods are usually smoky, dusty, and dirty, and frequently are really dangerous from the poisonous matters which are poured into the air from the factories. Thus the neighbourhood of brick-fields and chemical works should be avoided. The locality of grave-yards is unhealthy, because of the injurious gases which permeate the soils, and even the air of the districts in which they are situated.

CHAPTER XXXII.

TREATMENT OF SLIGHT WOUNDS AND ACCIDENTS.

Conduct in Cases of Accidents.—Treatment of Cuts.—Bleeding.—Burns and Scalds.—Bites and Stings.—Bruises.—Sprains.—Foreign Bodies in the Eye, Nose, Ear.—Fits and Fainting.—Drowning.—Suffocation and Poisoning.

IN the preceding pages some few of the most important causes and conditions regulating the health of the body have been explained, and where possible some simple instructions have been given as to the manner in which the healthy activity of the various organs may be maintained and disease prevented. We will now explain the way in which persons accidentally injured may be immediately relieved, and give outlines of the course to be adopted in sudden emergencies, when no medical adviser is at hand.

In all cases of accident, in a very great measure, the safety of the injured one depends upon the first steps taken by those around to relieve the sufferer. Accidents we know may occur at any time. If then from the following lines you learn how to act simply and efficiently in such emergencies, you will have the pleasing satisfaction of knowing that you have gained that knowledge which may

enable you at any moment to soothe the suffering, alleviate the pain, expedite the cure, or even to save the life of a fellow-creature.

It is necessary in all cases of accidents to pay particular attention to the following points, in order that you may be of real service, and that your treatment may be attended with the greatest success :—

1. Try to be collected, calm, and decided; and before adopting any mode of treatment make up your mind definitely as to what you intend to do. Having decided upon a certain course, carry out your intentions calmly and firmly, paying no attention to modifications suggested by bystanders, which may cause delay and increase the sufferings of the injured one.

2. Lay the patient in a position which is the most comfortable—usually on the back, and so in a horizontal position; but if a difficulty is experienced in breathing by the patient when so placed, then slightly raise the upper part of the body.

3. Loosen the clothes, especially those about the neck, chest, and waist.

4. If the body of the patient feels cold, cover it with blankets; restore warmth by friction or other artificial means, unless the coldness is attended by copious bleeding.

5. Do not administer stimulants unless the patient is completely exhausted, or remains in a fainting condition for more than twenty minutes, and even then only give small quantities.

Small cuts or wounds are often produced, which are not of sufficient importance to need the advice of a surgeon, yet such are often rendered very troublesome or even dangerous by unskilful treatment. Great care should always be exercised, therefore, even in the treatment of cuts and simple wounds. The wound should be washed with a little warm water if at hand, if not with cold; or cold water may be allowed freely to flow over it, the wounded place being afterwards wiped with clean linen. Such a mode of treatment secures the removal of dirt or foreign matter. The cut edges should then be pressed together, and held in their places by strips

of plaster placed at right angles to the direction of the cut. When the plaster is so adjusted, any discharge from the wound is allowed to escape between the strips. If the plaster is applied in the direction of the length of the wound, it prevents the escape of any discharge which may be produced, and hence tends to produce sores.

Where cuts are more serious it becomes necessary to modify the mode of treatment, according to the kind of vessel from which the blood is escaping. The blood is contained in the body in **three kinds of blood-vessels**—namely, vessels with thick coats, which carry blood from the heart—**arteries**; vessels with comparatively thin coats, which convey the blood to the heart—the **veins**; and the very minute and thin-walled vessels which connect the smaller arterial branches with the small veins—the **capillaries.** The arteries are usually more deeply seated than the veins; in fact, most of the blood-vessels which are found near the surface of the body are veins—that is, those vessels along which the blood flows to the heart. Bleeding may be the result of wounding any one, two, or more of these different kinds of blood-vessels. The blood contained by these three classes of vessels varies in colour—that present in the arteries being bright red or scarlet, and that of the veins dark red, whilst that which is found in the capillaries is intermediate in colour.

The difference in the way in which the blood leaves the vessels as well as its colour, enables us to readily determine the source from which it comes. The blood which issues from a wounded **artery** is of a bright red colour, and spurts forth or is jerked out in jets corresponding to the beats of the heart, whilst that from a vein is much darker in colour, and flows in a continuous stream. In bleeding from capillaries the blood oozes from the wound.

Bleeding may generally be stopped by pressure properly applied. Remembering that the blood flows along veins towards the heart and along the arteries away from the heart, it becomes necessary to explain how and where the pressure should be applied in

the case of the two different kinds of vessels. Where bleeding is only from a wounded vein, if direct pressure will not stop the flow of blood, a ligature should be passed round the limb and made to tightly press on the cut end of the wounded vein, remote from the heart. In bleeding from the arteries the blood is jerked or spurts out from the cut end of the vessel nearer to the heart. If direct pressure on the spot from which the blood issues will not check the bleeding, in this case a tight ligature must be passed round the limb, and be made to press especially on the part of the wounded vessel which is nearest to the heart. If more than one kind of motion characterises the flow of blood from a wound, or the blood appears mixed in colour, we may infer that more than one kind of vessel is injured.

When bleeding is taking place from the external surface of the body from any cause, try,—*First*—Direct pressure on the part, and raise the limb above the level of the body. If the wound is in the leg, let the patient be placed on the back and raise the leg. The pressure may be produced by any soft substance, such as a handkerchief, sponge, cotton-wool, or even the fingers.

Second.—If the above means are not attended with the desired effect, but the bleeding remains unchecked by simple pressure, it is necessary to pass a tourniquet or ligature round the limb as tightly as possible *immediately above* the point from which the blood issues. A medical man should then be sent for, or the patient carefully removed to the hospital or to some place where surgical aid may be obtained. The ligature above alluded to may be made with a pocket-handkerchief, strips of cloth, rope, twine, or india-rubber cord.

Third.—In cases of scalp wounds, pressure can be made on the wound itself by means of some soft substance, such as a handkerchief, cotton-wool, or a piece of lint. If a pad is made of such a substance, and held pressed tightly down by the fingers, it will in most cases at once arrest the bleeding.

Fourth.—Bleeding from the face and jaws may generally be arrested in the same manner—that is, by using a pad to press the wounded part down upon the hard bones, which are beneath.

Fifth.—When the bleeding is coming from a diseased surface—abscess, ulcer, or such like—and direct pressure does not check the flow of blood, the wound should be bandaged tightly with styptic wool, which may be prepared by soaking good cotton-wool in a strong solution of alum or tincture of steel, and allowing it to dry gradually. If no styptic wool is at hand, then ordinary wool or linen rag soaked in cold water, and made into a pad, should be tightly bound over the wound.

Varicose veins are due to the giving way of the little valves which normally regulate the flow of blood in the veins—the weight of the column of blood being uncontrolled, causes the veins so diseased to become dilated. When a varicose vein in the leg has burst, the limb should be raised higher than the rest of the body, and a handkerchief or other bandage should be tied tightly below the wound.

Sixth.—In cases where blood flows from the nose as the result of injury to some of its blood-vessels, cold water or ice should be applied. Some persons are very subject to bleeding from the nose, by which means it not unfrequently happens that they lose a very considerable quantity of blood; in the case of growing children, and those suffering from debilitating diseases, this becomes a very serious matter, and means should at once be adopted to allay the flow of blood. In such cases the patient should be kept perfectly quiet on his or her back; cold being applied at the same time to the back of the neck, and a cold pad kept over the nose. If, however, such means fail to check the flow of blood, a piece of cotton-wool or styptic wool folded and tied to a piece of string should be introduced into the nose, and gently pressed upwards.

Seventh.—The vomiting or coughing up of blood in considerable quantities are symptoms of grave importance, which are often present in ulceration of the stomach and consumption in its many phases.

In such cases the best plan is to keep the patient as quiet as possible; he should not be permitted to speak under any condition, but should be allowed to breathe fresh air freely, and ice or iced milk or water may be given. If the bleeding is very considerable, a cold wet towel may be applied to the chest, and if the blood flows from a broken vessel in the lungs the patient should be allowed to inhale freely the vapour of turpentine mixed with steam. This may be prepared by mixing three tablespoonfuls of turpentine, with about a quart of boiling water—the mixed steam and vapour given off by which may be inhaled by the patient.

In cases of bleeding, the patient frequently becomes weak and faint. This is not necessarily a dangerous or serious sign, for the faintness, which results in a quietened or reduced circulation, facilitates the staying of the bleeding, for, the rate of flow and pressure being reduced, the blood sooner coagulates and forms little plugs of clot, which naturally close the injured vessels and check the flow of blood. Of course, if the faint is prolonged and the bleeding does not diminish, it becomes necessary to adopt means to revive the patient.

Burns and scalds vary in severity according to the source of heat, the kind of hot liquid by which they are produced, and the length of time during which the injured part is exposed to the action of heat. **Scalds** produced by hot oil or milk are more severe, as a rule, than those produced by water. The danger which attends this class of injuries varies with the part and the extent of the body involved; for example, even slight burns or scalds, which involve a large surface, are generally more serious than severe burns, which only affect a more limited area.

The *first* means that may be taken to relieve the suffering in the case of this class of injuries, is to pour over the injured part some linseed or sweet oil.

Secondly.—Carefully remove all clothing in contact with the part. If this cannot be easily done, the garments should be freely cut, in order that the pain and suffering may not be increased

unnecessarily by dragging the clothes over the injured part. The oil may be poured upon or between the clothes and the body, if the burn is severe, for the oil softens the cloth and facilitates the removal of the clothes, thereby reducing the chances of tearing away the skin.

Thirdly.—Soak some cotton-wool or lint in linseed or pure sweet oil, and apply it to the injured part, renewing the application from time to time. Carron oil, which consists of equal parts of limewater and linseed oil, is one of the best remedies which can be employed. Owing to the inflammable nature of our clothing, especially that worn by women and young children, it not unfrequently happens that the clothes take fire. In no case of accident is there greater need for presence of mind and coolness. Remember, that air supports, and is consequently necessary for, combustion; therefore, if a person's clothes take fire we should immediately adopt means to cut off the supply of air. This object may be attained by enveloping the person in a cloak, rug, blanket, or similar article. If a man witnesses such an accident, and nothing better is at hand, he may strip off his coat, and by rolling it round the person, effectually extinguish the flames.

Bites and stings.—*Bites* of animals with sharp teeth, such as cats, dogs, and fishes, may produce one or more punctured or incised wounds, or tear the flesh and produce a lacerated wound, or they may simply cause abrasions of the skin. The mode of treatment to be recommended will, of course, vary with the nature of the injury. Where the pain is severe, hot fomentations or poultices are most soothing in their effects.

A great deal of misapprehension exists as to the danger incurred by the bites of dogs, and it therefore will not be out of place to remark that there is no fear that hydrophobia will ensue unless the dog is affected with the disease.

The following notice with respect to the subject of hydrophobia has recently been issued by the Brown Institution:—

This disease occurs in dogs of all ages, and may appear at any

season of the year. It is recognised by a change of demeanour of the dog, which becomes dejected, morose, inclined to roam, and anxious to hide itself. The animal gnaws at wood, stones, or any refuse which it sees, snaps at imaginary objects, and becomes unusually excited by strange or sudden noises. It rubs its throat with its paws, as if striving to get rid of some object lodged there; at the same time there is a more or less abundant flow of saliva from the mouth. The animal is, moreover, very readily excited, and barks with a peculiar, harsh, strange cough. The dog will attack its master or animals of any kind; but it is most easily roused to fury by the presence of other dogs. It is feared and shunned by healthy dogs—not only when it attacks them, but when the disease is in a very early stage. There is throughout the disease no dread of water. Before the tendency to bite shows itself, the animal may be unusually affectionate to its master—licking his face and fawning upon him. In one form of the disease, called "dumb madness," there is a paralysis of the jaw, and therefore inability to bite. If a dog has shown any of the symptoms of madness mentioned above, or an unusual tendency to bite other animals, it should be at once loose-muzzled and securely chained up, but it is advisable that it should not be destroyed until it has been examined by some authority capable of determining whether the animal be rabid or not. Owners of dogs are warned of the danger they may incur by allowing their faces and hands (especially if scratched) to be licked by the animals, even if these show no sign of madness. All dog-bites should be immediately cleansed by suction and washing, and the wounds should be cauterised as soon as possible.

Stings.—The pain caused by the stings of wasps and bees or hornets may be lessened by a few simple precautions. The sting should be first carefully extracted, and it is a good plan to then press the barrel of a key firmly round the part. This precaution will prevent the irritating poison from spreading. As the poison is mostly of an acid nature, the application of a little of an alkali like

hartshorn to the injured part will produce immediate relief. Common soda will answer very well; and in many cases an application of soap, oil, or glycerine to the injured surface has been found useful.

Bruises and sprains.—When a part of the body is *bruised* it becomes swollen and discolored, assuming a blue or blackish tint. Where the skin is not broken the discoloration may not be seen at first, but in the course of a few days the surrounding skin becomes yellow or red and blue. The discoloration and swelling are due to the escape of blood into the surrounding tissues; the part should, therefore, be kept at rest and cold should be applied. The injured part should be bathed and kept cool by the application of very cold water. A piece of ice wrapped in linen and made into a cold pad is of great service. In cases where a bruise is associated with abrasion of the skin, it is a good plan to first apply a little *vaseline* to the wounded surface, and then place the cold pad or ice in position.

The *sprains* of muscles and joints are often exceedingly troublesome injuries to recover from. They require, in the first place, absolute rest for the part injured. An application of heat gives the greatest ease, therefore the part may be bathed with hot water. The addition of some sea-salt to the water will increase its usefulness. After bathing, hot bran, linseed, or bread poultices should be applied, and must be frequently changed.

Some prefer to adopt the "cold water cure." The object then is to keep down the temperature of the injured part by the repeated application of cold water. When the swelling is passing off, the part should be rubbed and carefully exercised. Too prolonged rest is not advisable, as the part may become stiff.

Fainting, fits, and sudden illness.—When a person becomes insensible through *faintness*, it becomes necessary to decide at once what means to take for his or her recovery. The following simple rules will be found of general use in such cases, but may, of course, be varied according to circumstances:—

1.—Lay the person flat on the back, without a pillow for the head; in fact, if it can be arranged, it is better for the head to be lower than the rest of the body.

2.—Loosen all tight parts of the dress, especially about the neck, chest, and waist.

3.—If in a close-heated room, church, theatre, etc., remove the patient to the fresh air at once.

4.—Smelling salts or spirits of hartshorn should be held near the nostrils.

5.—If the faint continues, cold water should be sprinkled over the face; and should the patient not recover then, cold water may be applied to the chest. A towel dipped in cold water will answer for this purpose very well.

6.—On the return of consciousness, if the patient remains weak, administer stimulants in small doses.

When a very weak person is attacked by a **fit,** care should be taken to loosen all tightly-fitting clothes, and place the patient on his back. If the fit is accompanied by restlessness or convulsions, cold should be applied to the head, and the patient should be restrained, so that he does not sustain injury, and if consciousness does not soon return, medical advice should be obtained.

It not unfrequently happens that well-intentioned people try to force liquids into the mouths of those suffering from convulsions; it is, therefore, well to remember that this practice is attended with the greatest danger.

Convulsions in children call for great promptitude on the part of those at hand. If the child is fairly strong it should be placed in a warm bath, and the head should be kept cold by a piece of linen or flannel soaked in cold water. If the child is weak, then a blanket bath may be administered instead of the warm-water bath.

Foreign bodies in the eye, nose, and ear.—It not unfrequently happens that particles of dust, pieces of stone, metal, insects, etc., lodge under the eyelids, and give rise to much irritation. Any of the above may usually be removed with the

folded corner of a handkerchief. If much dust has passed under the eyelid it may generally be removed by carefully syringing with warm water. After the removal of the irritating substance, if the eye continues to be painful, it is a good plan to drop between the lids a little sweet or castor oil. If the pain still continues, a cold, wet compress should be applied. Quicklime, pieces of mortar, or other matters which are likely to irritate and burn, sometimes find their way under the eye-lid. They should be removed as speedily as possible, and the eye should be bathed with warm water and a little oil dropped between the lids as before.

Young school children not unfrequently push pieces of pencil, parts of toys, beads, etc., into the nostrils. They should, if possible, be at once carefully removed; if it is difficult to do this, a surgeon should be consulted.

Flies and insects sometimes find their way into the ears. Sometimes school children introduce into the tube of the ear bodies similar to those passed into the nose. The ear may, in such cases, be syringed out with warm water, and a little glycerine or oil may be dropped into the passage; but if the body is a solid, like a bead or piece of pencil, and it is not washed out by the syringing, then medical aid should be called in. It is advisable in such, for the inexperienced not to try to remove the foreign body except by syringing, for efforts to remove the irritating substance may result in injury to the delicate drum of the ear.

The following system of restoring the apparently dead, recommended by the Royal Humane Society, is known as the "Silvester Method."

If from drowning, suffocation, or narcotic poisoning.—Send for medical assistance, blankets, and dry clothing, but proceed to treat the patient instantly.

The points to be aimed at are—first, and immediately, the restoration of breathing; and *secondly*, after breathing is restored, the promotion of warmth and circulation.

The efforts to restore life must be persevered in until the arrival

of medical assistance, or until the pulse and breathing have ceased for an hour.

RULE 1.—*To adjust the Patient's Position.*—Place the patient on his back on a flat surface, inclined a little from the feet upwards; raise and support the head and shoulders on a small firm cushion or folded article of dress placed under the shoulder-blades. Remove all tight clothing about the neck and chest.

RULE 2.—*To maintain a Free Entrance of Air into the Wind-pipe.*—Cleanse the mouth and nostrils; open the mouth; draw forward the patient's tongue, and keep it forward: an elastic band over the tongue and under the chin will answer this purpose.

RULE 3.—*To imitate the Movements of Breathing.*

First.—**Induce inspiration.**—Place yourself at the head of the patient, grasp his arms, raise them upwards by the sides of his head, stretch them steadily but gently upwards, for two seconds. [*By this means fresh air is drawn into the lungs by raising the ribs.*—See Fig. 33, INSPIRATION.]

FIG. 33.—INSPIRATION.

Secondly.—**Induce expiration.**—Immediately turn down the patient's arms, and press them firmly but gently

downwards against the sides of his chest, for two seconds. [*By this means foul air is expelled from the lungs by depressing the ribs.*—See Fig. 34, EXPIRATION.]

FIG. 34.—EXPIRATION.

Thirdly.—**Continue these movements.**—Repeat these measures alternately, deliberately, and perseveringly, fifteen times in a minute, until a spontaneous effort to respire be perceived. [*By these means an exchange of air is produced in the lungs similar to that effected by natural respiration.*]

When a spontaneous effort to respire is perceived cease to imitate the movements of breathing, and proceed to induce circulation and warmth (*as below*).

RULE 4.—*To excite Respiration.*—During the employment of the above method excite the nostrils with snuff or smelling-salts, or tickle the throat with a feather. Rub the chest and face briskly, and dash cold and hot water alternately on them. Friction of the limbs and body with dry flannel or cloths should be had recourse to. When there is proof of returning respiration, the individual may be placed in a warm bath, the movements of the arms above described being continued until respiration is fully restored. Raise the body in twenty seconds to a sitting position,

dash cold water against the chest and face, and pass ammonia under the nose. Should a galvanic apparatus be at hand, apply the sponges to the region of diaphragm and heart.

Treatment after natural breathing has been restored.—*To induce circulation and warmth.*—Wrap the patient in dry blankets, and rub the limbs upwards energetically. Promote the warmth of the body by hot flannels, bottles or bladders of hot water, heated bricks, to the pit of the stomach, the armpits, and to the soles of the feet.

On the restoration of life, when the power of swallowing has returned, a teaspoonful of warm water, small quantities of wine, warm brandy and water, or coffee should be given. The patient should be kept in bed, and a disposition to sleep encouraged. During reaction large mustard plasters to the chest and below the shoulders will greatly relieve the distressed breathing.

Note.—In all cases of prolonged immersion in cold water, when the breathing continues, a warm bath should be employed to restore the temperature.

If from intense cold.—Rub the body with snow, ice, or cold water. Restore warmth by slow degrees. It is highly dangerous to apply heat too early.

If from intoxication.—Lay the individual on his side on a bed, with his head raised. The patient should be induced to vomit. Stimulants should be avoided.

If from apoplexy or from sunstroke.—Cold should be applied to the head, which should be kept well raised. Clothing removed from the neck and chest. Stimulants avoided.

Appearances which generally indicate death.—There is no breathing nor heart's action; the eyelids are generally half-closed; the pupils dilated; the jaws clenched; the fingers semi-contracted; the tongue appearing between the teeth, and the mouth and nostrils are covered with a frothy mucus. Coldness and pallor of surface increases.

The treatment recommended by the society is to be persevered

in for three or four hours. It is an erroneous opinion that persons are irrecoverable because life does not soon make its appearance; as cases have come under the notice of the society of a successful result even after five hours' perseverance, and it is absurd to suppose that a body must not be meddled with or removed without the permission of a coroner.

SYLLABUS OF THE SCIENCE AND ART DEPARTMENT,

SOUTH KENSINGTON.

1888.

SUBJECT XXV.—HYGIENE.

Elementary Syllabus.

1. Food, Diet, and Cooking.—Classification and uses of food substances. Animal food, vegetable food, condiments ; diet, requisites for maintenance ; cookiug, roasting, and boiling ; advantageous preparation of food ; cooking apparatus.

2. Water and Beverages.—Different kinds of water ; sources of water, good drinking water ; sources of contamination of water, and its deleterious effects ; cisterns and wells ; tea, coffee, and cocoa—preparation and effects ; fermented drinks—effects.

3. Air.—Amount of air necessary for each person ; movements of air brought about by changes of density ; composition of air ; impurities of air ; deleterious gases.

4. Removal of Waste and Impurities.—Principles of ventilation ; natural ventilation ; washing and soap ; removal of parasites ; danger of dirt ; removal of house refuse.

5. Shelter and Warming.—Materials of clothiug ; sufficiency of clothing for infants and adults.

6. Local Conditions.—Soil and its drainage ; aspects ; elevation—hill, plain, and valley ; distance from the sea ; influence of surrounding objects ; winds.

7. Personal Hygiene.—Habits ; exercise ; rest aud sleep ; cleanliness, attention to the action of the skin and bowels.

8. Treatment of Slight Wounds and Accidents.—Treatment of cuts, burns, scalds, bleeding, fits, drowning, suffocation, poisoning, bites, and stings.

For divisions of above Syllabus, see Table of Contents, pages V. to VII.

QUESTIONS

ON THE

CHAPTERS OF THE BOOK.

Chapter I.

1. What are the objects and scope of Hygiene ?

2. Explain what you understand by "preventable diseases" and give examples.

3. Show the necessity for taking food.

4. At which periods of life are abundant supplies of food most necessary, and why ?

Chapter II.

5. Classify the various food stuffs, and give your reasons for so doing.

6. Explain fully the functions devolving upon the nitrogenous food stuffs.

7. What is the use of carbonaceous food ? What changes do such food stuffs undergo in the body ?

8. What are the chief mineral substances present in food ? Why are they necessary.

Chapter III.

9. Mention some of the more important nitrogenous food stuffs, and state whence they are obtained.

10. Write out a short account of albumen, gluten, and starch.

Chapter IV.

11. Mention some of the more important animal nitrogenous foods, and give their relative value.

12. Give an account of fish as a food. Upon what condition does its nutritive character depend ?

13. Compare and contrast eggs and cheese as foods.

Chapter V.

14. Name some animal foods rich in carbon, and point out their action in the body.

15. Compare Butter and Butterine as foods.

Chapter VI.

16. Give examples and an account of some nitrogenous food of vegetable origin.

17. What is the action of brown bread as a food, and upon what does its value depend?

Chapter VII.

18. What are the more important vegetable foods rich in carbon, and what food stuff is chiefly present in them?

19. What is the action of green vegetables as foods?

Chapter VIII.

20. What are condiments? Describe their general action on the body.

21. How do you distinguish spices from condiments?

Chapter IX.

22. Mention some spices and describe their action on the body when taken with food.

23. What is the action of fruits and vegetable acids as foods?

Chapter X.

24. Describe the composition of milk. Why is it considered such a good food?

25. Is condensed milk generally to be regarded as a good food for infants? Mention conditions regulating its value.

Chapter XI.

26. Give examples of dietaries for different amounts of work. Show how sex, age, habits of life, etc., may influence the diet.

27. What are the advantages of a mixed diet?

Chapter XII.

28. Describe the changes taking place in cooking a joint by boiling, baking, and roasting.

29. Contrast the changes taking place in frying, baking, and roasting.

30. Point out some of the advantages gained by cooking food.

31. Describe the changes taking place in boiling and grilling.

CHAPTER XIII.

32. What precautions must be adopted in re-boiling a joint?
33. Describe the changes taking place in cooking vegetables.
34. How would you cook potatoes?
35. Describe the preparation of soup.
36. Mention some unwholesome dishes, and give your reasons for considering them as such.
37. Mention some food easy to digest, and some which are difficult to digest.

CHAPTER XIV.

38. What rules should be observed in eating?
39. What conditions are conducive to easy digestion?

CHAPTER XV.

40. Compare rain, spring, and well waters in point of purity, and liability to contamination.
41. What are "hard" and "soft" water, respectively?
42. How may hard water be softened?
43. What are the disadvantages attending the use of hard water for domestic purposes?

CHAPTER XVI.

44. Mention the characters of pure water.
45. Give an account of the chief impurities, (*a*) mineral, (*b*) animal, (*c*) vegetable, which are liable to occur in water. Mention the chief diseases liable to follow the use of impure water.
46. How may the organic impurities of water be got rid of?
47. In what way do organic matters usually find their way into water?

CHAPTER XVII.

48. Show how cisterns should be treated to ensure freedom from contamination.
49. Give some simple tests for the more common impurities of drinking-water.

CHAPTER XVIII.

50. Describe the chief methods of purifying water for drinking purposes.
51. Describe the construction and action of some good form of water-filter.

Chapter XIX.

53. Describe the nature, and action of tea, coffee, and cocoa, when taken as food.

54. Contrast tea and coffee as beverages.

55. How should tea be prepared ?

56. Write out a list of hygienic rules respecting drinking.

Chapter XX.

57. What is the value of alcoholic drink as a food ?

Chapter XXI.

58. Describe the action of alcohol on the organs of the body.

Chapter XXII.

59. What is the composition of pure air ?

60. Mention some of the impurities found in air; state their origin.

Chapter XXIII.

61. What is the composition of expired air, and what is the origin of the impurities found in it?

62. Describe fully, the effects of breathing impure air.

63. About how much water and carbonic acid gas are given off from the lungs of a healthy man in twenty-four hours?

Chapter XXIV.

64. What proportion of carbonic acid gas renders air unfit for breathing?

65. How would you calculate the amount of space needed to accommodate a given number of persons (say five) as regards healthy breathing?

66 Show how winds become available for ventilation purposes. What do you understand by the diffusion of gases?

67. What is preflation?

68. What diseases are liable to be produced by the various kinds of dust present in air, as the result of manufacture, etc.? Give examples.

69. What is the principle upon which McKinnell's ventilator acts?

70. Describe the action of Boyle's air pump ventilator.

71. Describe fully the principle means of ventilating an ordinary room.

72. What do you understand by the terms "artificial" and "natural" ventilation?

73. Describe some simple means of testing the purity of the air of a room.

74. Give some practical hints on ventilation.

Chapter XXIVb.

75. What do you understand by the "conservancy systems" for the removal of house refuse ?

76. Describe the water "carriage system" and point out its advantages.

77. In what cases is the dry earth system of removal to be preferred ?

Chapter XXV.

78. Give a short account of the structure of the skin.

79. How does the skin act as an organ of excretion ?

80. Give some account of "care of the nails."

Chapter XXVI.

81. Point out some special advantages of "Turkish Baths."

82. Give the characteristics of good soap, and point out the advantages of using such.

83. Give an account of the action of hot, cold and tepid baths respectively.

Chapter XXVII.

84. Is the use of medicated soap as a rule to be advised ? Give your reasons.

Chapter XXVIII.

85. Give an account of some of the usual causes of "baldness," and point out the precautions to be adopted.

Chapter XXIX.

86. Give an account of some of the parasites liable to be found in the food of man.

87. Describe the trichina spiralis.

88. How are "ring-worm" and scabis produced ?

89. Give some rules to be observed for the avoidance of parasites.

Chapter XXX.

90. What are the materials usually employed for clothing ?

91. Compare silk, wool, cotton, and linen as materials for clothing.

92. What are the most suitable materials for underclothing, and why ?

93. Show how the use of belts and tight lacing are injurious.

94. How should infants be clothed ? Point out some very prevalent error in the mode of dressing young children.

95. At what periods of life is warm clothing most necessary ? Give your reasons.

96. Name some of the injurious substances used in dying clothing materials, and point out their baneful effects.

97. What effects are produced by wearing tight shoes and boots?

Chapter XXXI.

98. Give some rule which should regulate one in the selection of a site for a house.

99. What influence has the light and aspect on the health of a house?

100. What do you understand by the term "made soils"? Are they considered good or bad? Give your reasons.

101. Describe fully the influence of the surroundings on the healthiness of the dwelling.

Chapter XXXII.

102. How would you know an artery had been wounded, and how would you treat such a wound, (*a*) in the arm, (*b*) in the leg?

103. Describe how you would, in an emergency, manufacture a tourniquet.

104. How would you treat small cuts and wounds?

105. What course would you adopt to stay the bleeding from a varicose vein?

106. How would you treat a serious burn?

107. How would you treat bleeding from the lungs or stomach?

108. What treatment would you adopt in the case of a snake bite?

109. How would you treat a dog bite? And why?

110. Describe the course of action to be adopted in the case of a serious snake-bite.

111. How would you treat a bruise or sprain? Give full directions and reasons for the same.

112. Describe how you would recognise (*a*) a fainting fit, (*b*) an epileptic fit, (*c*) an apoplectic fit?

113. What course of action would you advise in each of the above cases?

114. How may foreign bodies be removed from the eye, nose, and ear respectively?

115. Show, fully, how a case of supposed drowning should be treated?

116. What are the usual indications of death?

EXAMINATION QUESTIONS SET BY THE SCIENCE AND ART DEPARTMENT, SOUTH KENSINGTON.

First Stage or Elementary Paper.

INSTRUCTIONS.

You are permitted to attempt only eight Questions. The same value is attached to each Question.

1884.

1. Explain in detail why it is necessary to change the air of an inhabited room.

2. What are the uses of food? What are the "food substances," or "proximate constituents," of food? Do any foods contain them all?

3. What is the importance of cleansing the skin? What are the results of want of cleanliness?

4. How are soils classified for hygienic purposes? Which are the most healthy soils? Why is it important that the soil under houses should be drained?

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5. Why are young children so susceptible to cold? What rules would you lay down about their clothing?

6. How is meat changed by the process of boiling in water? What rules would you observe in boiling a joint?

7. What are the characteristics of a good drinking water? What effects are ascribed to the drinking of water contaminated by sewage?

8. What is the composition of cocoa? Compare it with coffee as an article of food.

9. What are the causes of natural ventilation? How may ordinary sash windows be used to ventilate rooms properly?

10. Explain the movements of the air at the sea border. Of what importance are those movements?

11. What influence does exercise exert over the muscles, the circulation of the blood, and the nervous system?

12. Describe a method for inducing artificial respiration.

1885.

1. What is the normal composition of the air? How is it affected by the respiration of human beings?

2. How is drinking water likely to be contaminated (*a*) in wells, (*b*) in cisterns?

3. What are the reasons for cooking food? How should a joint be roasted, and why?

4. Explain the importance of bodily exercise; why is rest necessary?

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5. Why is common salt a necessary food? Whence is it obtained? What important mineral salts are contained in foods?

6. What is meant by "hard" and "soft" water? Which is better for domestic use, and why?

7. How can the external air be admitted into rooms without producing draughts, (*a*) through the windows, (*b*) through holes in the walls?

8. How much air is necessary for each person per hour, and why?

9. How do winds act as ventilating agents? How may their action be utilised?

10. Compare wool and cotton as materials for articles of clothing.

11. What influence has (*a*) elevation above the sea, (*b*) distance from the sea, on the climate of a place?

12. A person has swallowed oil of vitriol; what would you do?

1886.

1. What natural forces may be utilised in the ventilation of rooms? Give sketches of some simple appliances which may be used for this purpose.

2. What refuse matters are produced in a kitchen? What should be done with them?

3. What are proper sources of drinking water for villages and for towns? How may a suspected water be rendered harmless for drinking?

4. Why is sleep necessary? Do children or adults require more sleep, and why?

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5. What is the relative importance of the changes produced in air by respiration?

6. Compare the flesh of fish with butcher's meat as food. Mention some important differences in the flesh of various kinds of fish.

7. Why do children require to be well clothed? What are the best materials for their clothes, and how should they be cleaned?

8. Why is the drainage of the soil of a town necessary, and how should it be carried out? In what kinds of soil is drainage most essential?

9. State the composition of (*a*) an "average" diet, (*b*) a "subsistence" diet, and give an example of the former with ordinary foods.

10. What food substances especially aid the action of the intestines? What is the importance of regular action?

11. What are the physiological effects of alcohol and of alcoholic drinks used in moderation and in excess?

12. A person has been run over by a cab, his arm is apparently broken, and is bleeding fast; what would you do?

1887.

1. Classify the food substances which do not contain Nitrogen. How are they disposed of in the system?

2. What kinds of wells are there? What are the characters of the waters yielded by them?

3. Compare and contrast tea and cocoa as beverages.

4. How are movements of the air in rooms produced? How large an inlet opening for air is required for each person, and why?

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5. What are the differences between air in towns and air in the country? What is the importance of these differences?

6. What animal parasites may be found on the surface of the human body? How may they be got rid of?

7. How should a dust-bin be constructed? What kinds of refuse should be put into it, and what not? How is it likely to become a nuisance?

8. At what periods of life is warm clothing most necessary, and why?

9. What are the disadvantages to health of living in crowded courts surrounded by higher buildings?

10. How are the breezes at the sea-side produced, and what effect have they on the healthiness of sea-side places?

11. Why is it important to keep the skin clean?

12. How would you treat a bad scald?

1888.

1. What are the most important food substances containing Nitrogen, and how are they disposed of in the system?

2. What are the advantages of cooking by gas? What conditions should a gas cooking oven fulfil?

3. What do we mean by hard and soft water? Which is the better for domestic purposes, and why?

4. What is meant by 'fermented' drinks? State the value of alcohol as a food substance?

5. How is the water of shallow wells liable to pollution? What diseases have been produced by the use of such water?

6. What is the composition of air? What are the variations in the amount of carbonic acid in pure air?

7. What is the composition of expired air? Why is it unfit to breathe again?

8. What are the forces which produce natural ventilation? How may the action of wind be practically utilized?

9. Describe the appearances of wool, cotton, and silk fibres, and state the advantages of each as a material for clothing?

10. How does height above the sea affect the climate of a place?

11. What are the effects of bodily exercise on the respiration, circulation, and digestive apparatus?

12. How would you detect and arrest the bleeding from an artery?

INDEX.

LIVERPOOL: UNION PAPER AND PRINTING COMPANY.

DR. PILLEY'S PHYSIOLOGY, 1/6.

Containing all the Questions set in the Elementary Stage at the Physiology Examinations, from 1874 to 1888.

Specimen Page.

The **Sphenoid** (Gr. *spehn* = a wedge) **Bone** forms part of the base of the skull. It is somewhat wing shaped, and forms a kind of wedge between the other bones forming the floor of the brain box.

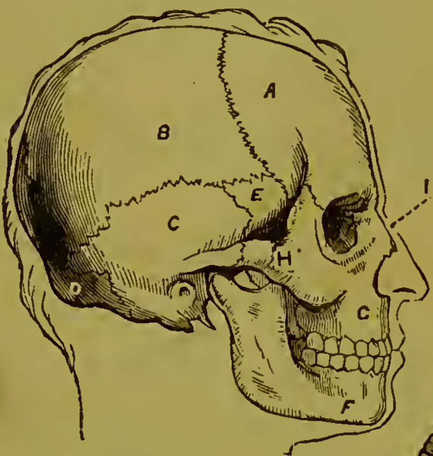
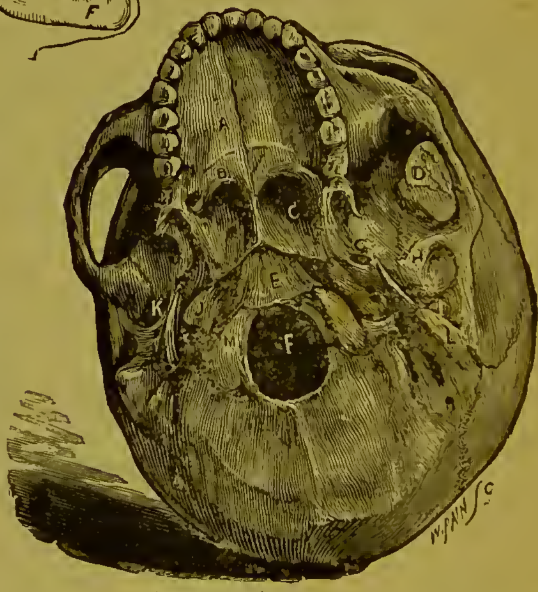


FIG. 5.

SIDE VIEW OF SKULL.

A.- Frontal.
B.—Right Parietal.
C.—Temporal.
D.—Occipital.
E.—Wing of Sphenoid.
F.—Inferior Maxilla.
G.—Superior Maxilla.
H.—Malar.
I.—Nasal.



W. SWAINSON

FIG. 6.

BASE OF SKULL.

A.—Showing Superior Maxillæ.
B.—Palate.
C.—Vomer.
D.-Part of Sphenoid
E.—Basilar Process of Occipital.
F.—Foramen Magnum.
G.—Foramen Ovale.
H.—Temporal Bone.

The **Ethmoid** (Gr. *ethmos* = a sieve) **Bone** forms the base of the front part of the skull, so that it is situated at the